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CONTENTS

PAGE

The Role of Learning in the Feeding Behavior of Black-chinned Hummingbirds.....*Frank Bend* 3

Differentiation of the Scrub Jay, Aphelocoma coerulescens, in the Great Basin and Arizona.....*Frank A. Pitelka* 23

The Hawaiian Goose, Its Distribution and Reduction in Numbers.....*Paul H. Baldwin* 27

FROM FIELD AND STUDY

California Condors in San Luis Obispo County, California.....*Halbert T. Johnson* 38
Notes on Raptors in the Boulder Area, Colorado.....*Malcolm T. Jollie* 38
Diving Habits of the Shoveller Duck.....*Clarence Cottam* 39
Foster Parentage of a Mourning Dove in the Wild.....*Johnson A. Neff* 39
Kingfisher Nesting near Whittier, California.....*J. H. Comby* 40
English Sparrows versus Robins.....*Frank Richardson* 40
Lawrence Goldfinch Eating Egg of Mourning Dove.....*James L. Ortega* 41
Snow Bunting in New Mexico.....*Donald F. Hoffmeister* 41
Another Southern California Record of the Tennessee Warbler.....*C. V. Duff* 41

NOTES AND NEWS..... 41

MINUTES OF COOPER CLUB MEETINGS..... 42

Museums
of
Wilson Ornithological Club

THE CONDOR

VOLUME 47 JANUARY-FEBRUARY, 1945 NUMBER 1

THE ROLE OF LEARNING IN THE FEEDING BEHAVIOR OF BLACK-CHINNED HUMMINGBIRDS

By FRANK BENÉ

Investigations of learning behavior in animals below humans have been carried on for the past fifty years, beginning with the concept of trial-and-error learning as employed by Lloyd Morgan (1894). A review of the literature, however, reveals that learning behavior in wild birds has received only scant attention. Watson and Lashley's studies of orientation in Noddy and Sooty terns are perhaps the most notable of early experiments with wild birds, although they were more interested in searching for the mechanism of orientation which guides birds in migratory flight than in investigating the learning process itself. As far as captive and domestic birds are concerned, Thorndike's (1898) work with chicks and Whitman's (1919) work with pigeons are outstanding, the former for introducing the concept of associative learning and the latter for showing the effects of conditioning on delayed sexual instincts.

This paper is a study of the learning behavior of the Black-chinned Hummingbird (*Archilochus alexandri*), based on observations and experiments conducted over the past five years in Phoenix, Arizona. During the spring and summer months of 1939 and 1940, and the spring of 1941, I spent an average of four hours daily in observation or experimentation. Less intensive work was done in 1938, 1942, and 1943. Of the two dozen or so individuals observed, eight served as subjects in feeding experiments.

In this paper the term learning refers to that process whereby the bird modifies original or instinctive ways of behaving. The product of learning may be an acquired or perfected skill, a conditioned response, a habit, or a behavior pattern. In testing the learning product three criteria are applied: (1) the learning activity must show repetition of trials; (2) change in behavior must result from this repetition; (2) this change in behavior must be constant enough to leave no doubt that learning has taken place.

It is not always possible to distinguish instinctive behavior from learned behavior, but we can with reasonable reliability recognize a product of learning in an experimental situation by applying the above criteria. In applying these criteria to an experimentally devised learning situation, we might be troubled by the supposed necessity of identifying the behavior pattern that is being modified. Is it a pure instinct or something that has already been learned? If it is an instinct, the criteria apply; if it is an act already acquired but undergoing further change, the criteria still apply. It is not the purpose of this paper to mark off succeeding stages in the modification of an original reflex or other behavior pattern. If the definition for learning given above includes modification of any subsequent stage, then any behavior that is modified in the light of the criteria set forth legitimately falls within the scope of this study.

I am grateful to the Boston Society of Natural History for granting me permission to use selections from an unpublished manuscript which I had previously submitted to them in competition for the Walker Prize.

FEEDING ADAPTATIONS

A general description of the feeding adaptations of hummingbirds at this point will indicate the possible directions learning takes. Observation of a hummingbird engaged in feeding discloses a versatility of motor skills—hovering about plants as though suspended from its wings, pirouetting in mid-air, flying backward, forward, upward, downward, from side to side like a pendulum—all performed with the greatest precision and ease. A hummingbird is indeed peculiarly adapted for rapid, intricate maneuvering about flowers and for extracting the nutriments within them.

As pointed out by Ridgway (1892:292), the hummingbird's aerial proficiency is made possible by such anatomical features as (1) short upper arm and long hand bones which gain for the bird a rapid wing stroke, (2) long, recurved processes of the bones supporting the tail which make possible well-developed caudal muscles that help the bird balance itself while hovering and assist the wings in backward flight, and (3) large pectoral muscles essential to rapid, prolonged flight.

The bill and tongue are highly specialized for extracting nectar and minute insects from the innermost recesses of most flowers visited by hummingbirds. The bills of North American species are quite uniform in shape and differ from each other chiefly in size. The bills of the small species occurring in the United States average about three-fourths of an inch in length while those of the Blue-throat (*Lampornis clemenciae*) and Rivoli (*Eugenes fulgens*) hummingbirds measure about one and one-fourth inches.

The tongue is tubular for part of its length and the tip fimbriated (Lucas, 1891). There remains some doubt as to the precise manner in which liquid foods and tiny insects are taken from flowers. According to Lucas, there can be no sucking action since the posterior section of the tongue is so constructed as to prohibit the creation of a vacuum or even partial vacuum. Gosse (in Ridgway, 1892:289) suggests capillary action as the mode of drawing up liquids, and this is quite possible.

The viscous saliva secreted by a hummingbird and the fimbriated tip of its tongue make possible the capture of minute insects in flowers. As my observations reveal, a hummingbird has voluntary control of the forked tip of its tongue, but whether the bird searches out the hidden insects with its tongue or finds them haphazardly is not clear. Exposed insects obviously are perceived visually. The tactile and visual senses seem to predominate in insect-feeding and the bird appears to respond largely to the size, color, form and movement of insects and spiders.

The perceptual mechanism involved in the selection and recognition of aerial insects and spiders is not as freely open to experimentation as is the mechanism involved in the selection and recognition of flowers, but if the hummingbird utilizes experience in perfecting its flower-feeding technique, there is no reason why it should not perfect its insect-feeding technique in a comparable manner.

The food of hummingbirds includes hymenopterans, hemipterans, dipterans and spiders. These include a multitude of bug-like, fly-like and spider-like species. Taken as a whole, those chosen by hummingbirds are noted for their small size and dark color. The source of these insect foods is varied. Inside the flower corollas minute thrips abound, whereas outside the corollas and on the surfaces of the plant parts predominant insects are black- and green-backed beetles; vines, shrubs and trees are visited for certain spiders which suspend themselves by their silk; and at dusk the air teems with gnats which constitute a large portion of hummingbird diet. The insects which hummingbirds consume, therefore, either move about in full view of the hummer or are concealed and must be sought out.

It is clear that the tongue is adapted for procuring both insects and nectar. The

tubes are intended solely for drawing up liquid foods since they are too small to permit the passage of even the smallest beetles found in flowers. Capillarity alone is insufficient to draw liquid into the crop. When the liquid fills the tubular tongue, the tongue must be emptied. This is done by the contraction and dilation of the tongue muscles which force the liquid out of the tube through the posterior end into the crop. Extending the tongue narrows the tube, thus increasing capillary action, whereas retracting the tongue not only draws the tongue back toward the oesophagus but also widens the tube so that emptying of it is facilitated. When exposed to the air for a few minutes, the tongue dries and the bird loses control of it. Wetting the tongue with water restores action almost instantly.

BEHAVIOR OF IMMATURE BLACK-CHINS

This part of the study deals with two pairs of nestling Black-chins. Data for the first pair are available for fourteen days of their nest life, from April 20 to May 4, 1939. The nestlings succumbed on May 4, after the parent bird either deserted them or was killed. Data for the second pair were collected during their entire nest life and during a fortnight after they left the nest, altogether from April 24 to May 29, 1943.

Food responses of nestlings.—During the first few days after hatching the nestlings lay so deep in the nest that their food response could not be observed directly. But the behavior of the parent bird on the nest as she fed the young, together with the nature of the feeding-brooding routine, at least indicated the nestlings' response to the parent bird. Later, by experimental means, it was possible to observe the actual food response of the nestlings.

During the first two or three hours after the first bird hatched, the parent visited the nest frequently, but instead of perching on the rim of the nest and waiting for the food response of her young, she poked her bill deep into the nest and jabbed, then dropped on the nest to brood. This action is unlike the feeding action that followed later in the day when the bird paused on the nest, then at the appropriate moment regurgitated food as she pointed her bill down into the nest. Once the adult bird waited fully a half minutes on the rim of the nest before delivering her food.

Over a period of five hours, the adult bird visited the nest and poked her bill down into it on an average of 2.8 times per hour. The next day, when the second bird hatched, the number of trips dropped to 2.1 per hour. When the nestlings were three and four days old, the rate was 2.1 trips per hour. In a similar study (Bené, 1940:209), the rate of feeding two- and three-day-old nestlings was 2.3 times per hour as compared with 2.1 reported in this study.

Once the feeding routine is established, it appears that the parent bird does not feed the young until the food response is given. On those occasions when the parent flew to the nest and immediately poked her bill down into it, she might have been attempting to feed the young or she might have been arranging shell fragments or nest material. This seems to be borne out by the following data. When the feeding routine is well established, the number of trips to the nest to feed the young increases from day to day. Referring to the nestlings observed in 1939 (Bené, 1940:209), the number of trips per hour to feed young increased as follows: April 20, 2.3; April 23, 2.4; April 27, 2.5; April 29, 3.0; and May 1, 3.1. From these figures it would seem that 2.8 trips per hour recorded for the first day in the study in 1943 is much too high, particularly in view of the fact that only one nestling, not two, was being fed.

Though a form of reflex action, the food response is subject to modification; it becomes more efficient as the nestling gains experience. At first, when the nestlings are blind, the food response is given indiscriminately to a variety of tactile and auditory

stimuli, but gradually responses to those stimuli which bring no food are inhibited and responses to stimuli which bring food are facilitated. When a medicine dropper filled with honey was tapped against the bill of a nestling, the food response was immediately given and the honey was dropped into its gaping mouth; but after repeated tappings of the mandibles without delivery of honey, the food response of the nestlings was inhibited.

Tactile stimuli are the most effective in eliciting the food response, whether they be the touch of the female's bill, the touch of one's finger, or the tap of a medicine dropper. Even when the nestlings are able to see, they respond to tactile stimuli of a foreign nature so long as food accompanies them. This response is shown in the advanced stages of nest life, as late as two days before leaving the nest.

Tactile stimuli alone do not constitute the entire food-response pattern. As the feeding routine becomes established, the nestlings learn to associate such factors with the presence of food as the *purr* of the parent's wings as she approaches the nest, the fixed station on the rim of the nest from which she feeds them, and the sight of their parent. Regardless of the conditioning agents in the pattern, whether or not the food response is facilitated or inhibited will depend on the presence or absence of food in the associational pattern.

Probing response.—One of the nestlings which left the nest on May 15 spent most of its time perched in the vicinity of the nest, usually on a twig of a bird-of-paradise shrub. The other, which left the nest a day later, chose the sheltered twig of an ash tree. Neither made any attempt to probe the flowers within full view of their perches. They seldom changed perches, preferring to wait for the parent bird who visited them at frequent intervals. Approaching her young, the adult bird would delay the feeding act, intermittently flying up to the young, then retreating, as though prodding them to leave their perches. But the young birds did not move. At this stage the older fledgling was 22 days old. The only acts that bore any semblance to feeding behavior were the extension and retraction of the tongue, stropping the bill, and probing twigs and leaves with the bill.

As each day brought additional strength to the young, the parent bird prodded them more frequently. She was still feeding them on the thirteenth day after they had left the nest. By this time the young grew bolder in their flight from twig to twig and tree to tree, even hovering among the leaves for seconds at a time and probing the leaves on wing. But the bird-of-paradise, scabiosa, honeysuckle, and larkspur blooms visited by adult birds were ignored by the young. Once an adult male Black-chin flew to the blooms of a bird-of-paradise shrub, and probed within a few feet of one of the fledglings. The young bird watched the intruder feed. When he left, the fledgling still made no attempt to search the flowers.

Twelve days after this incident, on May 30, one of the young approached a bird-of-paradise bloom and probed it. Then it flew to the ash tree and hovered among the leaves as though searching for insects. At this date the young were rarely seen on the premises (fig. 2) and the parent bird scarcely visited them. After May 31, sixteen days after the older bird had left the nest, the fledglings were no longer seen. Not until June 6 were immature Black-chins seen again, when what seemed like one of the young appeared, probing the large fiery red blooms of a canna. It fed awkwardly and attempted to gain a foothold on the bloom it probed. During the latter part of June both young were feeding from syrup glasses in the yard, though how the birds discovered them escaped observation.

The original response of the young to flowers also escaped my observation, but of

significance is the fact that the young probed twigs and leaves as soon as they had left their nest. I failed to see any insects on these twigs and leaves.

As the immature bird acquired strength of flight the probing response underwent further development to include hovering. The probing-hovering response resembles the technique of the adult bird when it searches the leaves of trees for insects. At this stage the immature bird still lacked the perfected motor coordination aerial feeding demands. Even when it had extended its search for food to flowers, it still lacked the smooth, rapid maneuverability characteristic of the adult bird.

The probing response of hummingbirds is comparable to the pecking response of domestic chicks, but since neither the feeding mechanisms nor the diets of fowls and hummers are identical, a reliable comparison of the rate of learning is hardly possible. Breed (1911) found that at first chicks rarely succeed in getting the food pellet swallowed, missing it forty-five times out of fifty trials. After fifty trials a day for five days, they are successful eighty per cent of the time.

Whether the young hummingbirds recognize flowers as a source of food while still dependent on the adult bird for food was not conclusively evident in their behavior. With hummingbirds there can hardly be an association of the taste of liquid foods with the appearance of the source of food until actual contact with the food in the flower is made. And this association can be effected only through exploration or trial and error. The nestling hummingbirds in this study had experienced only the taste of sweets regurgitated into their mouths by their parent and the taste of syrup I artificially fed them. An observation of significance is the fact that while the fledgling birds were still dependent on the parent for food, they nevertheless did some independent exploring, hovering about the leaves of trees and probing them.

PERCEPTION OF FOOD SOURCES AND MODIFICATION OF RESPONSES

The hummingbird, mature or immature, does not conduct its search for food from one spot or center but attempts to respond to as much of the environment as it can. Any one observing a hummingbird can not fail to note the scope and intensity of its search for prospective sources of food. Should the probing response yield an insect, a direct association of the insect with the thing probed results. If perchance a flower instead of a leaf yielded the insect, a similar association would be effected. Exploration is the keynote to learning, as the results of experiments to follow will make clear.

Response to color.—It has been held that specific color preferences are shown by hummingbirds, but according to my own studies (Bené, 1941:237), the hummingbird does not inherit a preference for any particular color. Rather color preference may be conditioned by experience and training. Or, to put the matter in other words, a hummingbird may be trained to select a source of food regardless of its color.

It is generally agreed that for the light-adapted eye the maximal sensitivity lies in the yellow-green region, between wave lengths 580-530 $m\mu$ (Woodworth, 1938:539-550). If color sensitivity influences choice, then the color preferred would be yellow to green, not red as is commonly believed. Since hummingbirds visit flowers of all colors, there is no reason to believe that any single color or combination of colors is especially attractive.

Response to scent of flowers.—There is no evidence of a special olfactory sense that guides hummingbirds to flowers. If receptacles of strongly scented honey, such as orange honey fortified with fresh orange blossoms, are hidden in a flower bed, the untrained Black-chin ignores them, darting past the spot of the hidden honey without

stopping to investigate. Even hummingbirds trained to feed from glasses containing catclaw or orange honey failed to locate the concealed glasses. Of the flowers visited by hummingbirds only a small proportion are strongly scented. This, however, does not preclude the possibility that once a flower is accepted its scent enters into the total associational pattern of recognition.

The scent of a flower does not appear to warn the hummingbird of its toxic nature. Young hummingbirds exploring various flowers indiscriminately visit such obnoxious plants as the oleander (*Nerium*) only to leave them instantly upon contacting the corollas. My records show not a single instance of an adult bird probing the oleander, yet in Phoenix hummingbirds commonly build their nests on the twigs of this shrub.

Taste discrimination.—My experiments show that the Black-chinned Hummingbird can discriminate differences in the concentration of sweets like syrup and diluted honey. The reaction of an adult female to syrup and honey solutions of varying concentration is shown in table 1. Starting with a honey solution containing 5 drops of honey in one ounce of water, the experimenter gradually increased the concentration by 5 or 10 drops. The bird's rejection of the solution is indicated when she takes only two or three quick sips, and acceptance when she takes a short or long drink. Between 60 to 70 drops of honey in one ounce of water is the minimum threshold of acceptance, whereas for syrup the minimum threshold is 1½ teaspoonfuls of sugar per ounce of water. Undiluted commercial honey is also rejected since it is too viscous for the bird's tongue. Incidentally, at the minimum thresholds of 60 drops of honey and 1½ teaspoonfuls of sugar, the viscosities of honey and syrup solutions are about equal.

Table 1

Taste discrimination of an adult Black-chinned Hummingbird, showing minimum threshold of acceptance of syrup and honey solutions

Trip	Drops of honey per ounce of water	Reaction
1	5	2 quick sips
2	10	2 quick sips
3	15	2 quick sips
4	20	2 quick sips
5	25	2 quick sips
6	30	3 quick sips
7	35	2 quick sips
8	40	2 quick sips
9	50	2 quick sips
10	60	short drink
11	70	long drink
	Teaspoonfuls of sugar per ounce of water	
1	2	long drink
2	1½	long drink
3	1	2 quick sips

The kinds of sweets preferred by hummingbirds are matters of individual differences in taste. Most birds prefer syrup made with white sugar. Brown sugar syrup is least preferred. Commercial honey ranks next to white sugar syrup in preference. Some of the birds have even accepted syrup flavored with fruit juices and one bird I had nursed for a broken lower mandible accepted various combinations of syrup, honey, egg yolk, milk, limewater, and B_1 complex mixed in various proportions.

The associative process.—That hummingbirds associate the superficial features of a flower with the nutriments it holds may be shown experimentally. The experiment to be described is typical of several conducted with adults as subjects. The subject of

this experiment was an adult male Black-chin who was conditioned to feed from syrup feeders. Prior to the experiment he had been feeding from lilac-colored buddleia and pink, red, yellow, and orange nasturtiums.

In a preliminary experiment several nasturtium blooms with some of the spurs clipped were placed over the mouths of small vials and one-ounce wine glasses filled with honey or brown sugar syrup. These were hidden in the nasturtium beds so that the flower decoys could not be distinguished from genuine nasturtium blooms. Mistaking these decoys for real flowers, the bird probed them, discovered that they held an abundance of sweets, and thereafter looked for them in the nasturtium beds. From March 20 to 23 the bird discovered all the decoys, but his reaction to them varied, owing to conditions beyond the control of the experimenter. At times the flower decoys withered and clogged the vials. Bees that found the vials would keep the bird away from the decoys.

Fig. 1. Adult male Black-chinned Hummingbird drinking white sugar syrup; used as subject in experiment relating to associative process.

On March 24 a red nasturtium was placed over the mouth of a wine glass filled with honey and the decoy placed on a pedestal in a secluded spot on the porch (fig. 2) away from the bees but in contact with a nasturtium plant that trailed up a trellis. While probing some nasturtium blooms on the trellis, the bird stuck his bill into the decoy and look a long drink. He returned several times and drank unhesitatingly, although after each trip parts of the decoy were removed until only two petals, five sepals, and the stamens and pistils remained. At this last stage of deformity, the mutilated decoy began to move about in the honey as the bird touched it. On the sixth trip to the feeder, when most of the glass was exposed and only two petals remained, the bird refused to touch the flower, preferring instead others feeders with whole flowers in them.

Next day I repeated the experiment, beginning with a whole decoy. From 10:27 until 11:12 the bird responded favorably, but as soon as the mutilated decoy moved about in the honey the bird quickly withdrew his bill.

Up to this point the vials and glasses were filled with honey or brown sugar, but upon finding that the bird was partial to white sugar syrup I eliminated the first two foods and began the experiment anew. The time was 11:12. A summary of the bird's reactions after 11:12 is given in table 2.

Prior to the experiment the bird responded to the whole decoy. Whether the bird sensed anything unnatural about it was not indicated by his behavior. Later, response to the form of the whole flower was modified by the quantity of sweets it held. Preference for the ordinary supply of sweets in the natural flowers was transferred to the increased supply in the decoys, indicating that the bird is quick to perceive differences in the quantity of nutriments in sources of food.

The association of abundance of nutriment with the form of the food source proceeded to the point where the decoy no longer remained stationary. Not accustomed to

Table 2

Responses of a male Black-chinned Hummingbird to a decoyed artificial feeder

Time of trip	Condition of flower decoy	Bird's reaction
11:35	Whole yellow nasturtium	Accepts
11:40	5 sepals removed	Accepts
11:53	Middle front petal removed	Accepts
12:05	1 rear petal removed	Accepts
12:20	Remaining rear petal removed (Observation interrupted)	Accepts
2:05	No change in decoy	Accepts
2:42	1 front petal removed	Accepts
2:53	Remaining front petal removed	Accepts, departs, returns, and feeds
3:01	Stamens removed	Accepts, departs, returns, and feeds
3:16	Spur now 3/8" by 1/8"	Feeds hesitatingly
3:25	Spur removed from glass	Refuses to feed; flies to another feeder with whole flower in it
	(Spur restored to glass)	
3:35	Spur same size as at 3:16	Accepts; drinks even as bill pushes spur around glass
3:40	Spur now 1/4" square	Accepts, pushing spur around as he feeds
3:51	Spur 1/8" square	Accepts; bird tries to keep bill on moving spur
4:01	Spur 1/16" square	Accepts, but bill misses moving spur
4:18	Spur removed from glass	Accepts, aiming bill at speck of pollen on side of glass
4:28	Pollen removed	Accepts, drinking directly from glass

feeding from a flower that moved as it did in the experiment, the bird was forced to make another set of adjustments—from a stationary source of food to a moving one; from a whole decoy to a speck of pollen on the side of the glass, as though all the syrup came from that speck; and finally, from the changing form of the decoy to the fixed form of the glass feeder itself.

Other birds subjected to similar experimental study transferred the association from decoy to glass without the intermediate steps indicated in table 2. When the decoy was summarily removed, they would pause before the undisguised glass, at first a little bewildered at the sudden change; then they would become excited and probe other flowers aimlessly; finally they would plunge their bills into the glass feeders. After that they would drink unhesitatingly.

Some individuals sampled the feeders without the benefit of a disguise, as did four immature Black-chins three to five months old. But in these cases the birds were apparently searching for water, not food. They mistook the sweet liquid for water. I have seen young hummingbirds try various sources for water: the nozzle of a hose, a leaking faucet, the lid of a typewriter ribbon box. More often undisguised feeders are left unsampled, so that those who sampled them were evidently induced to do so by thirst.

Whatever may be the original response to flowers, the fact remains that response to different forms may be conditioned. At first the bird responds positively to the whole flower and is indifferent to the undisguised feeder, the latter providing an unfamiliar set of stimuli. Following contact with the sweets in the feeder and after a number of trials (though usually only one trial is necessary) the bird associates taste of sweets with the form of the feeder so that afterwards the sight of the feeder alone elicits the feeding response. The conditioned response to form of feeder has transfer value; that is, after acquisition of this response, the bird does not hesitate to sample all sorts of objects that

resemble in shape the feeder, such as an empty flower vase, a milk bottle, or even my empty pipe bowl.

Hummingbirds recognize food sources long after their discovery. Thus, after feeding repeatedly from receptacles of honey or syrup over a period of months, presumably the same individuals would recognize them upon returning to the yard six to nine months later. It is conceivable that hummingbirds are not only capable of recognizing flowers from which they had been feeding from year to year but also capable of adding new forms to their list through learning.

Association of taste with position of food source.—The experiment to be described not only shows the mode by which taste is associated with position of food source but also the rapidity with which the association is effected. The subject was an adult female Black-chinned Hummingbird who had been feeding regularly from syrup and honey glasses. At the time of this experiment no other hummingbird was visiting the premises. The experiment was conducted on the front porch of a house with the experimenter seated behind the window of a room adjoining the porch.

The subject was given a choice of three glasses placed on stands of various heights so as to facilitate the association of the contents of each glass with the height and position of the stand. The stand occupied by the glass containing plain water was 37 inches high; the middle stand occupied by the glass containing weak syrup was 33 inches high; and the stand occupied by the glass containing strong syrup was 30 inches high. The weak syrup contained ½ teaspoonful of sugar in one ounce of solution, not acceptable to the bird, and the strong syrup 2 teaspoonfuls of sugar in one ounce of water, acceptable to the bird. Learning was regarded as having taken place when the bird persistently visited the strong syrup to the exclusion of the other two. The bird's reaction and rate of learning is shown in table 3.

Table 3

Progress made by female adult Black-chin in learning to associate position of feeder with concentration of syrup

Trip	Time	Bird's reaction
1	4:07	Visits strong syrup and accepts
2	4:35	Visits weak syrup first and rejects; plain water second and rejects; strong syrup third and accepts
3	5:09	Visits strong syrup and accepts
4	6:05	Visits weak syrup first and rejects; strong syrup second and accepts
5	6:30	Visits plain water first and rejects; strong syrup second and accepts (Experiment resumed the following day)
6	8:15	Visits strong syrup first and accepts; plain water second and rejects
7	8:38	Visits strong syrup and accepts.
8	9:00	Same
9	9:21	Same
10	9:41	Same
11	10:01	Same
12	10:27	Visits strong syrup first and accepts; momentarily stops at weak syrup but does not sample it

The first two trips were largely of an exploratory nature. The bird discovered what the feeders held. Apparently, the bird's curiosity still persisted for the next four trips, for she continued to make random samplings. After the sixth trip learning registered and for the next five trips the association of the strong syrup with its position in the battery was definitely fixed. It is interesting to note that on the twelfth trip the bird

paused momentarily before the weak syrup, but aware of its weakness, flew off without sampling it. This is a genuine test of learning, for the bird inhibits its food response without actually contacting the unsatisfactory food. Of significance is the fact that though some fourteen hours had elapsed between the fifth and sixth trips, only one error was made.

The rate of learning can be hastened by introducing a distasteful substance. Table 4 shows the behavior when salt water is substituted for plain water. To disrupt the association formed in the previous experiment, the salt water was placed on the lowest stand, previously occupied by the strong syrup, and the strong syrup placed on the highest stand, previously occupied by plain water.

Table 4

Reactions of female adult Black-chin to substituted salt solution

Trip	Time	Bird's reaction
1	10:58	Visits salt water first and rejects vigorously; visits strong syrup and accepts
2	11:26	Visits strong syrup and accepts
3	11:44	Pauses momentarily before salt solution upon arrival; visits strong syrup and accepts
4	12:17	Visits strong syrup and accepts
5	12:55	Same
6	1:21	Same
7	1:50	Same
8	2:31	Visits salt solution first and takes a short sip but rejects vigorously; visits strong syrup and accepts
9	3:10	Visits strong syrup and accepts
10	3:51	Same
11	4:34	Same
12	5:09	Same
13	5:52	Same
14	6:17	Visits strong syrup first and accepts but upon leaving, momentarily pauses a foot away from salt solution

As compared with the previous experiment, learning registered after the first trip to the salt water. The only mistake made was on the eighth trip.

This pleasure-pain aspect of learning is universal among animals and the rate at which obnoxious or painful stimuli are avoided after contact is made does not vary greatly among different classes of vertebrates. The frog, according to Schaeffer (1911), when offered hairy caterpillars leaves them alone after ejecting the obnoxious insects four to seven times. Fish can master a similar lesson in short time, as Reighard's (1909) investigation of warning coloration demonstrates: When small fish of the genus *Atherina*, stained red and some made unpalatable with the tentacles of jellyfish, were fed to a colony of snappers, the snappers avoided the unpalatable ones after a few trials.

LEARNING THE PLACE

Foraging on wing over the landscape, the hummingbird is confronted with a maze of landmarks. But this expert marksman locates the object of its search with precision, be it a choice bed of larkspur, a lantana bush, honey feeder, or even a single flower among many like it. Should the bird perchance discover a single flower containing more sweet food than is to be found in others like it, that flower will be singled out for special attention.

By means of a simple experiment let us observe the procedure by which the bird

locates an object or site once discovered. The subject was a female adult Black-chin, who had yet to taste honey from feeders that other hummingbirds had discovered weeks ago. The target was a yellow nasturtium bloom. After pinching off its spur, the experimenter inserted the flower into a vial of honey, leaving the corolla exposed. The vial, a reservoir of honey diluted with water, served as an artificial nectary. The disguised feeder was fastened to a stick which was concealed in a nasturtium plant whose foliage was arranged to leave no clue that might serve as a reference point once the decoy flower was discovered.

The bird arrived and, darting from flower to flower, accidentally came in contact with the decoy into whose corolla she thrust her bill. Surprised at finding so much honey in a single flower that resembled others she had been probing, she bounced back, paused before the decoy, and immediately lunged forward to take another drink. A half dozen sips followed in quick succession before the bird flew away.

Returning a half hour later, the bird flew straight to the decoy from which she took a long drink. If she searched for the flower while descending, her movements gave no indication of it. Twice she visited the flower and located it each time without apparent difficulty.

After the third trip the decoy flower was removed, leaving the vial and top of the stick exposed. A half hour later the bird arrived and flew directly to the site of the flower, but finding a strange vial in place of the flower paused a few seconds, then cautiously sampled it. A succession of short sips followed. Thereafter the bird visited the vial in routine manner, locating it accurately on each trip.

The vial was then placed on a white stand ten inches higher than the stick and two feet south of the original site. The stick was discarded. The white pedestal supporting the vial stood in sharp contrast against a background of green vegetation. When the bird arrived, she flew straight to the old site as though the vial were still there, but finding no feeder, became bewildered and excited. She searched for the vial, but either it escaped her attention or she failed to associate vial-on-stand-two-feet-away with the original vial-on-stick pattern. Frantically she probed a half dozen nasturtiums in the immediate vicinity of the stand, returned to the old site, and continued the search for the vial. A minute or two of futile exploration ended, the bird flew to a nearby fence, eight feet away, where she perched listlessly on a cross wire. A few seconds later she left.

Not certain how strongly the bird had been conditioned to the vial and fearing that she would give up further attempts to find the feeder if withheld too long, the experimenter returned it to the original site and attached it to the stick. On her next trip the bird flew straight to the old site and found the feeder.

Vial and stick were then moved one foot south of the old position, where the feeder was easily discovered, but finding it in a new position, the bird paused a few seconds before thrusting her bill into the honey. The vial was next placed on a white stand in place of the stick; it was discovered and the characteristic behavior of hesitation and bewilderment ensued before the bird decided to drink.

Thereafter vial and stand were gradually moved to various sites in the order shown in the accompanying sketch (fig. 2), and the bird discovered them at each new site in much the same manner in which the previous discoveries were made.

Starting with vial-on-stick at 1, the bird followed the feeder to 2 where she learned to associate it with the stand. Each new site was learned by exploration. At position 8 she learned to feed from the hand of the experimenter who was seated in a chair adjacent to the stand. When the experimenter, chair, and stand were removed and the bird

deprived of the feeder, she flew to site 8, though the closest landmark was the hedge fence ten feet from the site.

If a feeder was removed from a feeding site which she was in the habit of visiting, the bird would search the spot, then fly to other familiar sites where she sought the missing feeder. At first, with two to four sites learned, when the feeder was removed the bird would visit the sites in the order opposite to that in which they had been learned. Later, as the pattern acquired the full quota of nine sites, the bird would make no systematic search and short cuts were taken. Not only all the old sites were visited and re-visited but as the bird grew more and more excited, she would try any place that impulse prompted her.

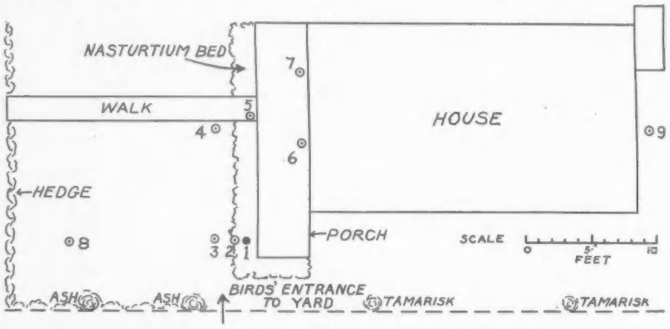

Fig. 2. Study area, showing order of location of feeders visited by an adult female Black-chin used as a subject in experiment on place learning. Distances between successive sites vary from 1 to 50 feet.

Of significance is the fact that the bird can locate accurately a site in the absence of the feeder or stand. The path to a site is taken quickly and with no apparent hesitation, save for a momentary pause preceding the actual search for the feeder. The bird has acquired a memory of old sites which she recognizes upon entering the yard.

After making one trip to an object, the bird retraces the path to it with seeming facility. If the bird must search for the object as she arrives in the yard, her flight does not indicate it, although the search may be so rapid that it can not be detected by the experimenter. It is much more rapid than the habits of orientation acquired by Noddy and Sooty terns that attempt to locate their nests when these are removed. Watson and Lashley's (1915) investigation of orientation in Noddy and Sooty terns nesting in a densely populated colony on Key West, Florida, led them to conclude that "Kinaesthetic-motor habits are formed with no such rapidity as to suggest that birds can retrace a path by memory of its direction and distances when these have been experienced only once."

Differences in rapidity of orientation between a hummer and a tern might be attributed, among other things, to differences in the learning situation. Nesting in a densely populated colony, a tern has to locate its nest among others similarly constructed and in close proximity to it, so that when the nest is removed a few feet from its original site, the tern finds its nest with difficulty. Still, the nest configuration facing the tern appears no more complex than the pattern of the flower bed in which a hummingbird singles out a flower similar in form and color to those surrounding it. Yet the hummer quickly locates that flower after the first trip. However, a hummer, like a tern, is thrown

into confusion when the position of its goal is changed. Then it must search until the goal is found, and the length of time spent in such exploration varies according to the distance the goal is moved from its original site.

Differences in the manner of locomotion may account for the difference in rate of fixing the path to a goal. A hummer explores the path and finds its way to the goal *wholly on its wings*; whereas a tern must explore partly by flight and partly by walking. Because it has an aerial view of the configuration all the way to the goal, a hummer can spot it with greater facility than can a tern, which, after alighting in the vicinity of its territorial preserve, must pick its way to the nest on foot, getting only a horizontal view of the path to it.

That an aerial perspective or what amounts to the same thing, an unobstructed view of the total configuration, facilitates perception of spatial relations has been demonstrated by experiments on apes solving simple problems of perception (Kohler, 1925). Such observations, of course, are more suggestive than conclusive and hence may be regarded only as a possible explanation of the situation in question.

The third explanation may be found in the hummer's adeptness at maneuvering in air. When the hummer is intent on visiting a source of favorite food, as a honey glass, it descends swiftly to the site of its objective and only momentarily does it hover before beginning to feed. The act preceding actual feeding is comparable to the tern's flight to the territorial preserve, after which the tern walks to its nest. Swiftness of flight, maneuverability, and ability to explore as it poises in mid-air appear to facilitate the hummer's perception of the goal configuration.

The comparative observations set forth indicate that for the study of orientation in hummingbirds, something finer than mere number of trips or trials as a measure of proficiency is needed; for in every case in which the source of food was visited only once, the second trip to it was made by the hummer without perceptible hesitation.

For the purpose of comparing place learning of hummingbirds with that of other animal forms, three methods of investigation are available. With winged insects and birds, a frequent procedure is one in which the configuration of the goal or the position of the goal itself is changed and the animal's reaction noted. Another procedure adapted for winged creatures is the investigation of homing flights, whereby the subjects are removed to a distant, alien locality and the speed with which they return to their nests, if they return at all, and their behavior are recorded. For animals adapted for terrestrial locomotion the most widely used learning device is the maze. The investigation of place learning for comparative purposes is thus seen to be complicated by the mode of locomotion of the learners, the nature of the goal sought, and the kind of learning device used.

PROBLEM-SOLVING

The desire to reach a source of food or a nest, or to preserve its freedom against possible confinement, motivates the animal's learning behavior. So long as these goals are attained, a state of well-being accompanies the learning activity; but should the path to the goal be blocked by an obstacle or barrier, the animal experiences a strong emotional state, the degree of emotion experienced depending on the extent to which the animal is thwarted in attempting to reach its goal. The obstacle creates (1) a problem which makes demands on the cerebral processes and (2) an emotional state whose function it is to reinforce those activities that are directed in pursuit of the goal. In the experiment to be described we propose to show that the mental and instinctive-emotional processes in a problematic situation are sometimes incompatible and hence inhibit the fulfillment of the learning task.

A feeder was placed in a box 18″ × 12″ × 12″ (see fig. 3), open on top, with an open window 6″ × 4″ on one side to permit the subject's entrance. The box was placed on a small table at the same place on the porch where previously the subjects had been feeding. On each side of the box was placed a feeder mounted on a stand. The purpose of these feeding stands was to restrict the experimental area to the porch and to attract to the box the subjects, B1 and B2, two adult female Black-chinned Hummingbirds.

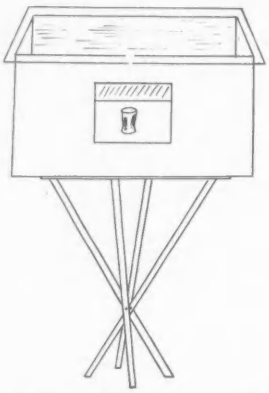

Fig. 3. Problem box used in experiments with hummingbirds.

When B1 arrived, she drank from one of the feeders and, as was expected, examined the box. B2 did likewise. The feeders were then taken from the stands and one of them was placed in the box. This preliminary phase disposed of, the experiment proper was begun.

To illustrate the inhibiting factors in the learning process, the column on the right in table 5 records the instinctive-emotional counterpart of the learning activities given in the column at the left. The impulse to feed is not of equal intensity at all times but increases or decreases according to the internal state of the bird. Increasing intensity is designated by "feeding-excitation," which means that the food-getting instinct dominates the birds. "Defense-excitation" indicates that response to confinement is dominant. Both the food-getting and defense instincts have their antagonistic correlates in "feeding-inhibition" and "defense-inhibition," respectively. The instinct of defense is manifested as a response to actual or potential confinement, as when the bird flies out of the box without drinking or when it cuts short its drink from the glass in the box.

So far we can hardly call this situation problematic; it entails learning of the most primitive, direct sort. Once the birds catch sight of the feeder in the box, the path to it can easily be grasped, whether the birds discover the feeder by spotting it from atop the box or at the side through the window. Since the top covers a larger area, both birds perceived the path to the feeder from atop the box. This discovery was made quickly, after random, exploratory movements about the porch. B1 found it in four trips to the porch, in exactly three minutes, and B2 on her second trip, in one minute.

More significant than the matter of solving this simple problem in this phase of our investigation is the role of instincts and their emotional correlates in the learning process. In the first place, the excess energy released by the emotional state is intended

Table 5

Learning behavior of two female adult Black-chins attempting to locate feeder in box

Time of Arrival	Learning behavior	Instinctive-emotional state
2:32	B1 arrives and searches for feeder, flying all over porch.	Feeding-excitation
	Departs without finding feeder in box.	Feeding-inhibition
2:33	B1 undertakes another search as above.	Feeding-excitation
	Departs without finding feeder.	Feeding-inhibition
2:34	B1 undertakes another search as above.	Feeding-excitation
	Departs without finding feeder.	Feeding-inhibition
2:35	B1 discovers feeder in box and looks at it suspiciously from atop the box.	Feeding-inhibition, defense-excitation
	Swings before box in pendulum fashion.	Feeding-excitation, defense-excitation
	Departs without entering box.	Feeding-inhibition, defense-excitation
2:36	B1 flies to box and inspects it.	Feeding-inhibition, defense-excitation
	Enters via top.	Feeding-excitation, defense-inhibition
	Refuses to drink; leaves box.	Feeding-inhibition, defense-excitation
	Repeats above acts three times.	Preceding two states repeated three times
2:41	B1 enters box via top, takes quick sip.	Feeding-excitation, defense-inhibition
	Flies out of box.	Feeding-inhibition, defense-excitation
	Enters and takes quick sip.	Feeding-excitation, defense-inhibition
	Flies out.	Feeding-inhibition, defense-excitation
	Enters and takes quick sip.	Feeding-excitation, defense-inhibition
	Flies out.	Feeding-inhibition, defense-excitation
	Enters and takes quick sip.	Feeding-excitation, defense-inhibition
	Flies out.	Feeding-inhibition, defense-excitation
2:48	B1 flies to box, hovers before it.	Feeding-inhibition, defense-excitation
	Flies to experimenter, seated ten feet from box, and hovers about his face, squeaking.	Feeding-inhibition
	Returns to box and enters via top.	Feeding-excitation, defense-inhibition
	Refuses to drink, flies out instantly.	Feeding-inhibition, defense-excitation
	Repeats above acts of entering box and flying out instantly without taking drink six times.	Preceding two states repeated six times
	Enters box and takes quick sip.	Feeding-excitation, defense-inhibition
	Flies out instantly.	Feeding-inhibition, defense-excitation
	Inspects exterior of box.	Feeding-inhibition
	Enters box via top, takes quick sip.	Feeding-excitation, defense-inhibition
	Flies out and inspects exterior of box.	Feeding-inhibition, defense-excitation
	Enters via top, takes quick sip.	Feeding-excitation, defense-inhibition
	Flies out and surveys surroundings.	Feeding-inhibition
2:50	B1 arrives and examines the interior of box, inspects table on which box sits, and looks underneath table. Then inspects stand at the side of the box.	
	Flies away without feeding.	Feeding-inhibition, defense-excitation
2:57	B1 returns and enters box, taking quick sip.	Feeding-excitation, defense-inhibition
	Flies out.	Feeding-inhibition, defense-excitation
	Repeats above acts three times.	Preceding two states repeated three times
2:58	B2 flies to vicinity of box but fails to see feeder in box.	Feeding-excitation
	Flies to experimenter and squeaks.	Feeding-excitation
	Departs without finding feeder.	Feeding-inhibition
2:59	B2 returns and flies to experimenter, squeaking.	Feeding-excitation
	Flies to box and discovers feeder, enters box via top, taking quick sip.	Feeding-excitation, defense-inhibition

for the benefit of the contending instincts—one driving the birds to feed, the other impelling them to stay clear of the menacing box. The clash of these instincts is evident in the rhythmical excitatory and inhibitory processes in which nervous and motor energy is expended. The obstacle, namely the box, calls into action the mental processes, but the instinct of defense persists in shunting it out of action intermittently, and not until the feeding instinct grows stronger and the birds become somewhat accustomed to the experimental situation do the mental processes gain sufficient control to direct the birds to the feeder. In time the birds reach their goal if but to take quick, cautious sips of honey.

Fig. 4. Adult female Black-chinned Hummingbird extracting nectar from blossoms of honeysuckle; this hummer designated B1 in experiment dealing with problem-solving.

There can be no doubt that perception of the path to the feeder, insight, intelligence, or whatever we call the process, is not wanting in birds. What keeps the mental processes from functioning smoothly is the difficulty of conquering fear. What is there about this open box that arouses fear in the birds? The way of escape is simple and perceivable to the most elementary mind. Yet the birds hesitate to enter and are dissatisfied with the easy avenue of escape open to them. They must critically examine top, bottom, and sides of the box. They swing in pendulum fashion before it. Under the stress of emotion they make useless, diffuse movements, all of which contribute nothing toward the attainment of their goal, save perhaps in the most remote way. What is the meaning of all this? From observations such as these it is evident that not the least important factor in learning is control of the instincts and deep-seated desires; perception of the path to the goal is not enough.

Up to this point neither bird had made any attempt to reach the feeder via the window. By placing a glass pane over the top of the box, we created a more complex problem than the preceding one. There was then only one path available to the feeder and this path could be perceived in two ways. The direct method was the simplest and to carry this through the birds needed only to come up to the window, catch sight of the feeder, and enter. This problem was the same as the preceding one. Another method would require that the birds, upon hovering atop the box, perceive the indirect or "roundabout" path to the feeder. A person would reason thus: "From atop the box I see the feeder six inches from the window. By going to the side I can enter through the window and thus reach the feeder." But this problem is difficult for the hummer, as table 6 discloses.

Table 6

Reactions of two female adult Black-chins to altered feeding source

Time of Arrival	Birds' behavior
3:14	B1 encounters B2 on porch and drives her off.
3:15	B1 makes no attempt to enter box; instead flies to the experimenter and hovers about his head.
3:17	B2 arrives and flies to box, tries to enter but is stopped by glass pane. Looks at box in bewilderment.
3:18	Tries again to enter box but is stopped by glass pane.
3:20	B1 makes no attempt to enter box; fails to see the feeder through the open window.
3:21	Tries to enter box via top but is stopped by glass pane. Flies to experimenter and squeaks.
3:24	B1 flies all over porch, investigating prospective sites for trace of feeder. Gives up search and flies to flowers nearby, probing a few blooms. Then flies to box, tries to enter via top. She gets very excited as she beats her body against the glass pane in the effort to reach the feeder.
3:27	Tries to get into box via top. Then flies to experimenter and squeaks.
3:28	Same behavior as above.
3:30	Same.
3:31	Same.

Both birds failed to solve this simple problem. B1 failed to see the connection in eight trips and B2 in two. Instead of going to the window, they beat their bodies against the glass pane. Before the pane was placed over the top of the box, they would enter with fear and sip honey nervously. But when entrance via the top was barred by the pane, they frantically strove to get into the box at all costs. The strong defense instinct, which had played a prominent role in inhibiting learning at first, was completely absent. Even stronger than before was the emotional state. B1, who had hardly noticed the experimenter up to this point, now flew to him greatly excited, squeaking loudly, after which she returned to the box and beat her body futilely against the glass pane. B2, on the other hand, was less demonstrative, but she, too, bumped her body against the glass in the attempt to make a direct entrance. But, strangely enough, she was not as emotionally upset now as she had been when faced with an open top.

Apparently, the birds' failure to solve this simple problem of entering must be attributed to one or both of these factors: (1) the problem was too difficult, (2) the emotional state blinded the mental processes, preventing effective learning.

The problem was simplified by moving the feeder up to the window, so that the birds could hardly miss sight of the feeder at the window. The bird needed only to fly accidentally to the window and catch sight of the feeder, part of the rim of which protruded from the window.

B1 arrived at 3:42 and instead of catching sight of the feeder in its new position, looked into the box from the top. Then she flew to the experimenter, squeaking. A minute later, at 3:43, she returned, looked at the feeder from atop the box, then flew to the window where she quickly discovered the feeder and took a long drink. The sound of her wings resounding in the box momentarily frightened her.

B1 solved the problem in the direct manner, but B2's behavior indicates that she found the solution in a "roundabout" way. She looked at the feeder from atop the box as she struck the pane and in a moment was at the side facing the window and the feeder, where she took a long drink.

The feeder was moved away from the ledge of the window back to its original position. We now have the same configuration as existed in the preceding situation, but this time both birds had been conditioned to the window, and hence we should expect that on their next trip they would fly directly to the window.

When B1 arrived at 3:44, she paused before the window, finally mustering enough courage to enter. Instead of drinking honey when she got into the box, however, the bird became excited and pushed up against the glass pane. The experimenter lifted the pane one foot above the box, but still the bird pushed against it frantically. Not until the pane was moved to one side did the bewildered and frightened bird escape.

B2 arrived at 4:27, flew to the window of the box, hesitated as did B1, then entered. She, too, became panic-stricken and tried to escape by pushing against the glass pane. The experimenter reached into the box; the bird's wings stopped beating at the same time—"playing 'possum." The helpless bird allowed herself to be grasped. Once out of the box, the bird struggled frantically to escape. Upon her release she at once flew to a high perch on an ash tree where she preened her feathers. B2 refused to approach the box thereafter.

In order to ascertain to what extent the birds profited from the fearful experiences of the preceding day, the experimenter moved the problem box out on the lawn, leaving the glass pane and feeder in the box intact. B2 did not enter, but B1 overcame her timidity and entered the box via the window on three different occasions, leaving the same way she entered it; but once in the box she refused to touch the honey.

How can we account for this successful exit, an exit she had failed to make the day before? In the preceding experiment B1 became panic-stricken the moment she entered the box, whereas the next day she saw the way of escape instantly upon entering. We have here a learning behavior that is comparable to that exhibited by B2 when she had quickly learned to avoid the salt solution after a rest interval of fourteen hours. B1's sudden solution of the simple entrance and exit might be attributed (1) to sudden *insight* into the problem, (2) to getting the solution before fear had a chance to nullify her perception, (3) to practice and rest, and (4) to slight change in the configuration of the problematic situation through placing the box on the lawn and giving the bird a different perspective.

It would seem that the instinct of defense and its emotional correlate, fear, was so strong the day before that the bird became flustered. On the instinctive side we observed acts of interest and significance. First, the instinctive tendency is to take the line of least resistance to a goal which may result in direct learning. Moreover, the fact that escape takes the direction of upward flight, together with the presence of fear, blinded the bird's perception of the path of escape. It is probable that the diminished fear of the next day made possible a clearer perception of the means of escape. Then, too, the bird's inexperience with glass and its inability to recognize it had contributed to the bird's failure the day before. Had there been an opaque partition on top of

the box, the flight of escape would not have been vertical but probably horizontal. We noticed that the birds tried repeatedly to get into the box by bumping onto the pane, while in attempting to get out they bumped upward against the pane. B2's death feint shows that a sense of helplessness inhibits all movements, resulting in the cessation of learning activity.

SUMMARY

While adaptation and specialization of feeding mechanisms determine the direction feeding behavior will take, the feeding habits of hummingbirds are modified by experience. The feeding mechanism is not fully developed in young hummingbirds until at least two weeks after they leave the nest. The earliest responses related to food-getting are probing with bill and tongue, first while perched and later while hovering. The recognition of flowers as sources of food appears after the young have acquired sufficient strength for sustained flight. The hummingbird's acceptance or rejection of flowers as sources of food is governed by experience.

The hummingbird exhibits no special sense for detecting nutriments in a food source at a distance but perceives the quality and quantity of nutriments after contact. It can discriminate the color, taste, and form of flowers and through association learn to recognize and locate them.

Hummingbirds learn to associate sites with specific sources of food and return to the site though the food source be removed. Apparently but one visit to a food source is necessary to establish an associational pattern.

Two female hummingbirds learned to visit a feeder in an open-top box with a side entrance. When a glass cover was placed over the top, both birds failed to solve the problem of reaching the food through the open side entrance after attempts to reach it from the top were thwarted. When the feeder was lifted to view from the side entrance, both birds found it. In both instances, however, feeding was inhibited once the bird entered the box by efforts to escape inclosure.

LITERATURE CITED

Bené, F.
1940. Rhythm in the brooding and feeding routine of the Black-chinned Hummingbird. Condor, 42:207-212.
1941. Experiments on the color preference of the Black-chinned Hummingbird. Condor, 43: 237-242.

Breed, F. S.
1911. The development of certain instincts and habits in chicks. Behavior Mono., 1:i-iv, 1-78.

Kohler, W.
1925. The mentality of apes (New York, Harcourt, Brace & Co., Inc.), viii + 342 pp. [Translated from the second revised edition by Ella Winters.]

Lucas, F. A.
1891. On the structure of the tongue in humming birds. Proc .U. S. Nat. Mus., 14:169-172.

Morgan, C. L.
1894. An introduction to comparative psychology (London, W. Scott, Ltd.), xiv + 382 pp.

Reighard, J.
1909. An experimental field-study of warning coloration in coral-reef fishes. Carnegie Inst. Washington, publ. 103:257-325.

Ridgway, R.
1892. The humming birds. Rep. U. S. Nat. Mus. for 1890:253-383.

Schaeffer, A. A.
1911. Habit formation in frogs. Jour. An. Behavior, 1:309-335.

Thorndike, E. L.
1898. Animal intelligence: an experimental study of the associative processes in animals. Psych. Rev., Mono. Suppl., 2:1-106.

Watson, J. B., and Lashley, K. S.
1915. Homing and related activities of birds. Carnegie Inst. Washington, publ. 211:1-104.

Whitman, C. O.
1919. Behavior of pigeons. Carnegie Inst. Washington, publ. 257, 3:xii + 161 pp.

Woodworth, R. S.
1938. Experimental psychology (New York, Henry Holt & Co.), xi + 889 pp.

Phoenix, Arizona, November 15, 1943.

DIFFERENTIATION OF THE SCRUB JAY, APHELOCOMA COERULESCENS, IN THE GREAT BASIN AND ARIZONA

By FRANK A. PITELKA

From the time the Woodhouse Jay of the Rocky Mountain and Great Basin regions (*Aphelocoma californica woodhousei* of the A.O.U. Check-list, 1931) was first recognized as distinct from the Florida and California jays, it has been regarded as constant in character throughout its range. Study of a collection of 588 specimens representing most parts of the range of this form has revealed a hitherto unrecognized differentiation into eastern and western divisions which now merit taxonomic distinction.

Apart from the obvious difficulty of bringing together an adequate series of specimens to establish the presence or absence of such differentiation, there are at least three possible reasons why it has not been described earlier. First, an adequate amount of fresh-plumaged material has not been available to most systematists since the specimens in most collections are, in the majority, spring- or summer-taken, worn skins. Second, much discussion of the Woodhouse Jay and its relatives has been concerned with racial versus specific status of the more strongly marked differentiates of the widely distributed complex of forms now recognized as the *Aphelocoma coerulescens* rassenkreis (A.O.U. Check-list Committee, Auk, 61, 1944:453); to some extent this has hampered the study of particular portions of the group. Third, in previous systematic studies of *Aphelocoma coerulescens*, racial characters have been defined without segregation of adults and first-year birds. The two age classes differ in that first-year birds bear juvenal wing and tail feathers which are significantly shorter than those of adults; in series, first-year birds are also duller and usually more variable in color (Pitelka, MS). Thus, precise characterization of races rests on the separation of these age classes.

Recently expressed nomenclatural opinion (Hellmayr, Catalogue of Birds of the Americas, 1934:51; A.O.U. Check-list Committee, *loc. cit.*) has favored the combination of the series of closely allied, allopatric forms including the Florida, Woodhouse, California, and Santa Cruz Island jays, under the specific name *coerulescens*. Questions of relationships among these forms are the basis of a revisionary study now in progress. Whether they should or should not be regarded as conspecific may remain a matter of opinion that will not alter the facts brought forth by detailed analysis of inter- and intra-racial differences; my studies have led me to adopt the course proposed by Hellmayr and followed by the A.O.U. Check-list Committee. The basis for this decision cannot be developed or discussed here; the reader, however, can refer to a recent statement concerning use of trinomial names in polytypic species by Schmidt (Ecol., 25, 1944:255), whose general point of view I share.

Brief comment is also in order on the question of vernacular names. With almost every advance in our understanding of racial differentiation in *Aphelocoma coerulescens* and with almost every taxonomic change, the application of vernacular names to the various races has become increasingly confused. I propose in my own work to drop all subspecific vernaculars and to use only one name, that of "scrub jay," for the rassenkreis as a whole.

Within the range of the race *woodhouseii* as formerly understood, scrub jays of the Great Basin and Arizona are significantly lighter-colored than those of the Rocky Mountains and New Mexico. These lighter western birds may be separated under the name

Aphelocoma coerulescens nevadae, new subspecies

Type.—Adult male, no. 28080, Mus. Vert. Zool.; 3 miles east of Jackass Springs, 6200 feet, Panamint Mountains, Inyo County, California, September 30, 1917; collected by Joseph Grinnell, orig. no. 4509.

Racial characters.—Similar to *Aphelocoma coerulescens woodhouseii*, but blue coloration of head and neck lighter and duller (between Tyrian Blue and Deep Orient Blue, closer to the former, in Ridgway, Color Standards and Color Nomenclature, 1912), hence less purplish; back duller, suffused with more gray or blue-gray, hence less brownish; undertail coverts lighter (Pale Windsor Blue-Light Windsor Blue). Bill longer (8.9 per cent, calculated on the basis of average lengths in groups 1 and 4, table 1), more pointed and more tapering; similar to *A. c. woodhouseii* in other dimensions.

Geographic distribution.—Principally the Great Basin and Arizona (fig. 5); southeastern Oregon and southern Idaho south to the Providence Mountains, California, and southeastern Arizona, west to Mono Lake and the desert ranges along the California-Nevada line, and east to central Utah, northeastern Arizona, and New Mexico.

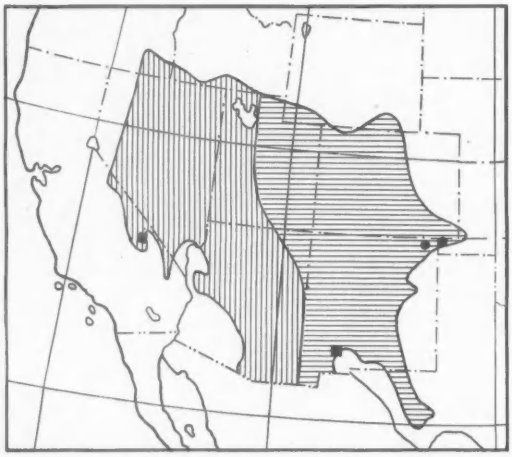

Fig. 5. Distribution of *Aphelocoma coerulescens nevadae* (vertical lines) and *A. c. woodhouseii* (horizontal lines) in the southwestern United States. Squares indicate type localities; circles indicate localities mentioned in the text from which representative specimens of *woodhouseii, sensu strictu*, have been examined.

Measurements.—Comparative data on size of adult males only are given in table 1 for five different geographic areas representing the total range of *A. c. woodhouseii* and *A. c. nevadae*. Statistical data on length of bill are compared graphically in figure 6. Measurements of the type are as follows: wing, 131.1 mm.; tail, 146.9; bill length, 21.8; bill depth, 8.5; bill width, 8.2; tarsus, 41.0; hind toe, 12.5; middle toe, 19.5.

Differences which separate the restricted race *woodhouseii* from *nevadae* are best seen in comparisons of unworn, *adult* specimens representing the eastern and western distributional margins of the two races, respectively. Gradual intergradation takes place over a more or less broad belt from western Colorado and central Utah south

through northeastern Arizona and western New Mexico. Because this intergradation is gradual and because specimens available from this north-to-south belt are limited in number, the geographic boundaries of the two races herein proposed are arbitrary and tentative.

Southwardly, in Arizona and central and southern New Mexico, differentiation of *nevadae* and *woodhouseii* is not so marked. Color differences, which are the chief basis for separation, are weaker; but in series, specimens of adults from Arizona are clearly assignable to *nevadae*, those from New Mexico to *woodhouseii*. With series of first-

Table 1

Measurements of adult males of *Aphelocoma coerulescens woodhouseii* and *A. c. nevadae*

	Number of specimens	Range	Mean and standard error	Standard deviation
A. c. woodhouseii				
(1) Western Texas and southern New Mexico				
Wing	18	124.1-132.2	128.67 ± 0.50	2.11
Tail	17	136.0-147.3	141.65 ± 0.74	3.07
Bill length	18	17.8- 21.6	19.73 ± 0.25	1.06
Bill depth	17	8.4- 9.0	8.66 ± 0.06	0.24
Bill width	18	7.3- 9.4	8.46 ± 0.12	0.49
Tarsus	18	37.9- 41.1	39.79 ± 0.20	0.87
(2) Colorado, eastern Utah, northern New Mexico				
Wing	50	125.0-136.8	130.92 ± 0.40	2.85
Tail	48	134.0-151.9	143.94 ± 0.55	4.17
Bill length	49	18.2- 22.9	19.93 ± 0.13	0.88
Bill depth	48	7.9- 9.5	8.57 ± 0.06	0.40
Bill width	48	7.5- 8.9	8.12 ± 0.05	0.33
Tarsus	49	37.0- 42.9	39.71 ± 0.16	1.10
A. c. nevadae				
(3) Arizona				
Wing	39	124.7-138.2	130.95 ± 0.49	3.05
Tail	38	137.2-153.1	142.68 ± 0.64	3.98
Bill length	39	17.7- 21.7	19.85 ± 0.15	0.95
Bill depth	38	8.1- 9.4	8.69 ± 0.05	0.34
Bill width	39	7.4- 9.2	8.27 ± 0.07	0.46
Tarsus	38	38.2- 41.7	39.70 ± 0.12	0.76
(4) Western Utah, Nevada				
Wing	17	128.1-133.3	131.29 ± 0.34	1.41
Tail	17	138.5-151.4	144.35 ± 0.87	3.58
Bill length	16	18.7- 22.8	21.48 ± 0.32	1.29
Bill depth	16	8.1- 9.4	8.70 ± 0.09	0.37
Bill width	16	7.3- 8.5	7.92 ± 0.09	0.38
Tarsus	16	38.0- 42.5	39.91 ± 0.28	1.10
(5) Mono, Inyo, and San Bernardino counties, California, and bordering parts of Nevada				
Wing	24	124.5-135.4	130.00 ± 0.54	2.66
Tail	20	134.6-147.3	142.10 ± 0.89	3.98
Bill length	26	19.4- 23.6	21.44 ± 0.23	1.15
Bill depth	26	7.8- 9.3	8.70 ± 0.07	0.38
Bill width	26	7.5- 8.9	8.13 ± 0.08	0.40
Tarsus	26	37.6- 42.7	40.31 ± 0.23	1.16

year birds, however, a separation of specimens adequate for systematic purposes cannot be made. Moreover, in size of bill, *nevadae* of Arizona does not differ from *woodhouseii* (fig. 6). A detailed discussion of the intergradation of *nevadae* and *woodhouseii* and of the relationships of these races to neighboring forms cannot be undertaken here.

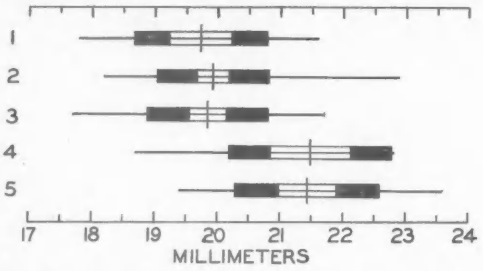

Fig. 6. Individual and geographic variation in length of bill of adult males of *Aphelocoma coerulescens* from five geographic areas (see table 1). Extreme limits of individual variation are shown by length of single line; the mean is shown by a short vertical line; the standard deviation is shown by a rectangle. The light portion of the rectangle represents twice the standard error. When these light portions overlap, as between groups 2 and 3, for example, the observed differences are not statistically significant (see Dice and Leraas, Contr. Lab. Vert. Gen., no. 3, 1936).

The type locality of the race *woodhouseii* is Fort Thorn, 10 miles west of Rincon, 4500 feet, Dona Ana County, New Mexico (Bailey, Birds of New Mexico, 1928:12, 48). This locality falls within the zone of intergradation between *woodhouseii* and *nevadae*. I have not examined the type nor any topotypes of the former, but a close study of specimens from southwestern New Mexico reveals that the majority are similar, or at least closer to the darker eastern form. On the basis of these comparisons, the name *woodhouseii* becomes applicable to the eastern differentiate, typical representatives of which have been examined by me from Kenton, Cimarron County, Oklahoma, and Folsom, Union County, New Mexico (fig. 5).

Museum of Vertebrate Zoology, Berkeley, California, December 15, 1944.

THE HAWAIIAN GOOSE, ITS DISTRIBUTION AND REDUCTION IN NUMBERS

By PAUL H. BALDWIN

The Hawaiian goose (*Nesochen sandvicensis*), known locally by the Hawaiian name, Nene, has existed through more than a century of white man's civilization. It is now much reduced in numbers and range. Even prior to the advent of the white man, it had the smallest range of any goose, as Miller (1937:1) points out. General statements regarding its distribution have been available for many years, but none is sufficiently detailed to satisfy the needs of the ecological investigator, who on the island of Hawaii must deal with a great diversity of climatic and vegetational conditions in adjacent areas. It is the purpose of this paper to present information on the distribution of the Nene gathered through visiting known localities of occurrence and interviewing ranchers and other outdoor observers. The laymen's records cited are considered reasonably reliable, for distinctive markings and habits render the Nene easy to identify in the field. Enough data on distribution were obtained to permit discussion on the course of the reduction in numbers and in range.

The writer gratefully acknowledges information and courtesies received from many persons. The work was especially aided by the following from Hawaii: E. G. Wingate, Superintendent of Hawaii National Park, Herbert Shipman of Puu Oo Ranch, Ronald von Holt of Kahua Ranch, Leighton Hind of Puuwaawaa Ranch, Mrs. Maude Greenwell of Puu Lehua Ranch, Frank R. Greenwell of Honokahau, T. A. Jaggar, formerly of Hawaii National Park, Maj. L. W. Bryan, formerly Territorial Forester on Hawaii, M. Martinson of Kahuku Ranch, Theo. Vredenberg of Huehue Ranch, Allen Wall of Kona, David Paris and Wm. Thompson of Kona, Eugene Horner formerly of Hamakua, C. E. Blacow of Hilo, H. W. Baybrook formerly of Puu Lehua Ranch, and Oliver Crosby formerly of Kona. Other contributors were F. A. Hjort of Maui and Senator F. I. Brown and G. C. Munro of Oahu. Information on museum specimens of Hawaiian geese was received from the Bernice P. Bishop Museum, United States National Museum, American Museum of Natural History, Museum of Comparative Zoology, Academy of Natural Sciences of Philadelphia, and the Museum of Vertebrate Zoology.

DISTRIBUTION ON ISLAND OF HAWAII

18TH AND 19TH CENTURIES

In 1789 Captain John Meares of the *Iphigenia* noted that twelve geese were sent on board at Kawaihae (Locey, 1937:5), and in 1792, Edward Bell (1929), clerk of the *Chatham*, recorded the purchase of two small geese at Kealakekua Bay (fig. 7) and mentioned that six dozen had been carried to sea by a previous party. Since we know that Nene were raised by Hawaiians in early times, we may assume these domestic geese to have been that species. The presence of domestic flocks may indicate that wild Nene occurred at these places. Later records show that South Kohala indeed was a natural home of the Nene, and one record indicates that the central Kona lowlands were visited by Nene.

The next record of the Nene was made in 1823 when Wm. Ellis (1917:180), the missionary, "saw two flocks of wild geese, which came down from the mountains and settled among the ohelo bushes, near the pools of water" at the edge of Kilauea Crater.

He learned from natives that "there were vast flocks in the interior." Again, it is reasonable to conclude that these geese were Nene, both from the natives' comments and from subsequent records of Nene at Kilauea Crater.

In 1824, Andrew Bloxam (1925:62), naturalist of the *Blonde*, mentioned wild geese. Although it is not indicated that he actually saw these birds, he wrote that approaching the volcano from Puna at a distance between six and nine miles from Kilauea, the party passed several pools of water "which are often the resort of wild geese which frequent this part of the country and live on purple berries." Evidently he also was given information on the goose by natives. No doubt these remarks refer to the Nene, for the food habits and frequent visits by the birds accord with known Nene habits.

In the period 1838-1842, the United States Exploring Expedition visited the Hawaiian Islands. They found geese "on the volcanic mountains of the Island of Hawaii" (Peale, 1848). In their account no specific localities or regions are mentioned, except that shallow ponds occurring "between the mountains" are said to be breeding places of the geese. They remark that they have not been able to find the goose named by ornithologists, and they do not use the term Nene. The type specimen of *Nesochen sandvicensis* now in the United States National Museum was collected on this trip.

Subsequent references contain an implication of declining numbers of Nene, and we may assume that the recession of this species in numbers and perhaps also in range was noticed shortly after the middle of the 19th century. In 1864 W. T. Brigham (1909:12) ascended Mt. Hualalai in North Kona, probably up the eastern slopes. His guide shot a pair of Nene between two cones, probably about 6,000 to 7,000 feet elevation. He remarks that the number of Nene "has been much underrated," which nevertheless implies that their number in less remote areas was no longer large, though they were still abundant far in the interior.

Charles Wall, a sheep rancher between Hualalai and Mauna Loa in North Kona from 1859 to 1875, is said to have reported that native geese were abundant in that region (Pope, 1932:110).

Slender evidence is available to show that the Nene range probably extended into North Kohala in 1875 to 1880. I have been told by Ronald von Holt that a Hawaiian, J. K. Kaiamakini, used to herd Nene flocks at Kahua about 1880. The possibility exists that these geese were obtained in a wild state at Kahua.

A visitor to Kilauea in 1884, MacFarlane (1887:212) says, "on the hills above the renowned volcano of Kilauea, there are still fair numbers of Hawaiian geese, *Bernicla sandvicensis*." The wording reveals again a general decrease in Nene on the island, probably evident throughout its entire range by now.

The situation during the 1890's is described in the accounts of Henshaw and of Perkins, the last statements to come from ornithologists who had first-hand knowledge of the Nene from field experience. Henshaw (1902:103, 105) says, "upon the island of Hawaii the haunts of the nene, for the greater part of the year, are the uplands from about 5,000 feet upwards. At or about the above elevation the range of this goose is quite extensive, and it is found from the district of Kona to the northeast flanks of Mauna Kea." He continues, "the greater number, probably all, leave the upper grounds beginning early in fall, and resort to lower altitudes, from about 1,300 feet downwards. There are barren lava flats near the sea in Puna, Kona, Kau, and Kohala, rarely visited by man, and it is to these deserted solitudes that the nene resorts at the beginning of the love season."

I have corroborated Henshaw's statement that Nene occurred on the northeast flank of Mauna Kea with one record: C. E. Blacow was once told by a rancher of Nene seen

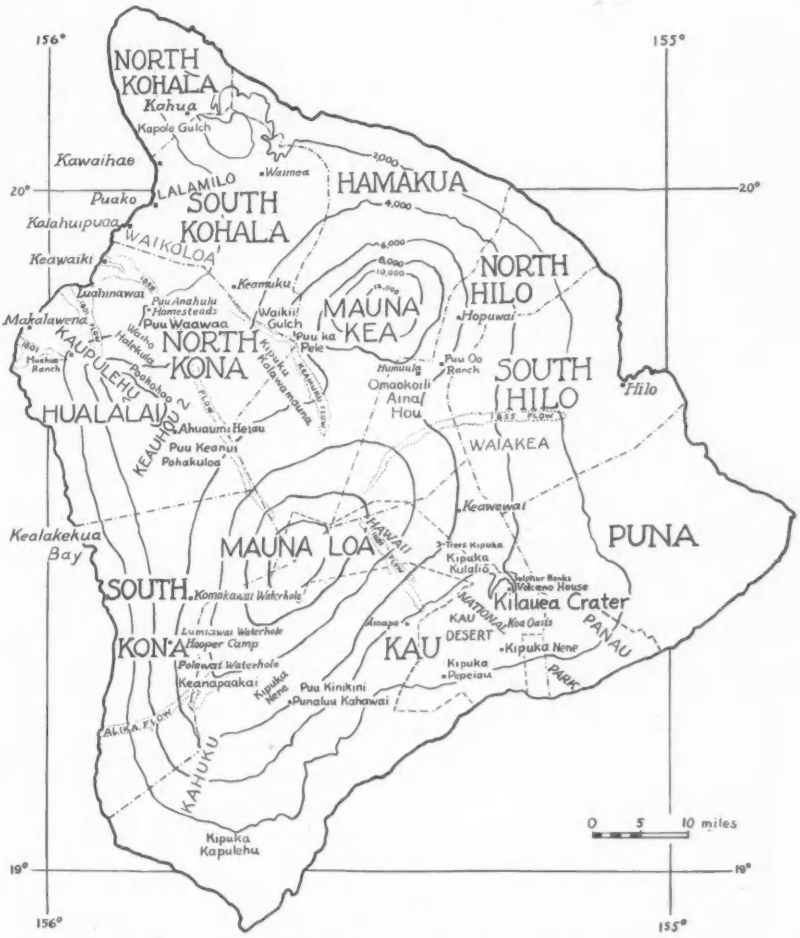

Fig. 7. Map of the island of Hawaii showing localities mentioned in the text.

about forty years ago near the Hopuwai Ponds. During this period the Nene range ended on the northeast flank and did not continue on around Mauna Kea to the north and northwest slopes. Mention of the Nene is absent from early accounts of the trail around these slopes.

As for the barren lava flats near the sea, it is unfortunate that we do not have the specific records upon which Henshaw's statement is based. It has been possible at this late date to obtain only meagre information on their use by Nene. The few following records pertain to these lowlands, supporting Henshaw's assertion.

An old Hawaiian resident of Puna, Sam Konanui, who travelled across the Puna

lowlands to Kau around 1894, says Nene were plentiful above the inshore cliffs around 1,500 to 2,000 feet but not on the flats which line the shore. He saw them as far to the east as Panau. On the lava below Kahuku in Kau, Nene were seen in the 1890's (Henshaw, 1902:106). H. C. Palmer and G. C. Munro collected Nene on the lava flow of 1801 near sea level in North Kona in December, 1891. In 1896, nine geese were shot along the Kaupulehu coast in North Kona by Captain Freeman (Locey, 1937:6). An Hawaiian informed von Holt that Nene formerly came to Makalawena on the shoreline in North Kona. Von Holt was likewise told by Hawaiians that they regularly made use of Nene for food at Kalahuipuaa in South Kohala and that Nene came to Puako several miles further north.

Perkins (1903:457-458) writes, "The nene is widely distributed on the island of Hawaii and in some localities is a fairly common bird. . . . In the summer months it affects the open upland region,—as parts of the plateau between the three great mountains of Hawaii, at an elevation of four or five thousand feet above the sea. Near the crater of Kilauea about two miles from the Volcano House hotel flocks of some size may be occasionally seen in the later summer." He continues, "In the winter months large numbers of these upland geese resort to the lowlands and remain there for such time as the vegetation is fresh and green."

A number of interview records can be added to our account of the 1890's. Flocks of 30-40 Nene were seen by Allen Wall during this decade at Aina Hou, a *kipuka* with grass and berry-laden shrubs on the north flank of Mauna Loa in North Hilo District at 6,000 feet. Not only did he see geese here but along the Humuula road and "all over the country between Mauna Loa and Mauna Kea." David Paris asserted that Nene were always to be found throughout the upper part of the Kona districts in the latter part of the 19th century. His uncle, J. D. Johnson, and an old Hawaiian, Charles Kaa, used to obtain living young Nene between Hualalai and Mauna Loa. Kaa also told Paris that flocks used to fly from above over the forests of lower elevations in Kona, including central Kona. Wall states that Nene were found everywhere between Mauna Loa and Hualalai and along the west slope of Mauna Loa to the south end of the mountain. Palmer and Munro collected Nene on Hualalai at the Huehue Ranch in North Kona around 2,000 feet but failed to find them between Mauna Loa and Hualalai in 1891. In 1899, J. Pritchard saw Nene scattered along the Ainapo Trail, Kau, below timberline (E. Horner).

20TH CENTURY

By 1900 the great decline in Nene numbers had occurred and the first investigations on Hawaiian birds had been made. Published records of Nene occurrence from then on lapsed.

Kona and Kohala.—In and above South Kona, Paris encountered pairs of Nene as late as 1936 two miles east of Keanapaakai, Kahuku, and two miles east of Komakawai waterholes at 7,250 and 7,000 feet, respectively. In May, 1937, O. Crosby observed a pair just above the Polewai Water Holes. In 1940, von Holt saw several flocks of five to eight from the Alika Lava Flow north to Hooper Camp from 6,750 to 8,000 feet, and early in 1944, W. Thompson found three on the lava above Komakawai Water Holes.

Nene still were observed occasionally between Mauna Loa and Hualalai at the turn of the century, but since then F. R. Greenwell has found them comparatively scarce. He noted the lower limit of their wanderings on the south side of Hualalai to be around 5,000 feet. From 1929 to 1931, H. W. Baybrook saw nesting at Pohakuloa in Keauhou 2, but not subsequently. L. W. Bryan observed a few in the driest part of the plateau

between Hualalai and Mauna Loa in 1932. The southeast flank of Hualalai just above the plateau has harbored small flocks through the years up to 1940, according to Greenwell, though nesting was not observed by him. Three were seen by Baybrook on the plateau at Puu Keanui and one near Ahuaumi Heiau in 1941.

On the west and southwest sides of Hualalai, Nene, if present at all, were scarce, as no records are at hand for any area south of Kaupulehu.

On the north slope of Hualalai about 1910, Paris came across Nene at the Kaupulehu Lava Flow along the Waimea road. Nene are recorded in later years from here. Wall caught goslings on the north slope about 1913 and has reared their offspring to this day. T. Vredenberg remembers Nene in fair numbers in 1942 along the edges of the Kaupulehu Lava Flow from 2,550 to 4,400 feet. The birds came to the grassy pahoehoe lava two miles east of the Huehue ranch house, and in November, 1942, 14 came to a watering trough one mile from the house. Recently Paris has seen one or two along the road by the Kaupulehu flow.

Apparently, Puuwaawaa Ranch includes the most populated nesting area today. The continuous presence of Nene since 1900 is recalled by L. Hind. In March, 1942, Hind saw 26 near the hill, Puu Waawaa, and once in 1941 he saw a flock of 33 there. During 1943 the largest flock he found was of 13. Nene nest especially in Waiho and Halekula, in paddocks between Puu Waawaa and Hualalai, from about 2,300 to 4,000 feet, according to Hind. One of his employees, T. Lindsey, reported nesting above Halekula in November, 1941, and in February, 1942, watched an adult with young at Poohohoo. He had noted also several at Halekula in March, 1942, and 16 at Waiho at 3,000 feet in April, 1942. On April 11, 1942, the writer saw five adults at 3,700 feet near Poohohoo.

The Puuwaawaa shoreline is visited by Nene, as Hind observed 19 at Luahinawai in 1937.

Nene were also seen in the adjacent lands of Puuanahulu both above and below the belt road in the homesteads area during the years around 1906 by Greenwell and by Eben Low, who told Paris that they bred here. From 1915 to 1930, E. Horner saw occasional pairs in the vicinity of the 1859 Lava Flow above and below the road. The last was seen about 1930. He once saw a pair flying toward the shore in the early morning and perhaps the same pair flying toward Mauna Loa that evening.

Several miles above the shore in Puuanahulu and Waikoloa are several grassy *kipuka* where Nene were known perhaps as late as the 1920's, according to F. I. Brown. Brown and von Holt occasionally have come across them near shore ponds just north of Keawaiki Bay during the past few years.

In the South Kohala district Nene were noticed near the seashore at Puako until 1915 (von Holt). The most northern specific records in South Kohala are in Lalamilo at 2,000 feet, where Lindsey saw "some nene" at Waiulaula Gulch in the early 1900's. Brown learned of seven here in 1941. Lindsey saw some south of here at Keamuku in Waikoloa at about 3,250 feet in 1925.

On the gentle slopes of Mauna Kea in South Kohala, Vredenberg in recent years saw "flocks of Nene" in Waikii Gulch at 4,150 feet. A pair built a nest containing three eggs on rough ground three miles northeast of Keamuku at 3,750 feet in 1940, according to Paris.

The northernmost record was obtained by von Holt when he disturbed a pair of Nene at Kapole (Waikapole) Gulch in Makiloa, North Kohala, at 800 feet in 1938. This is the only sight record from that district.

Interior of the Island.—Nene are frequently seen in the interior from Puuwaawaa to Aina Hou and from the latter place to Kau. Vredenberg reports that there was a small flock on the Keamuku Lava Flow immediately south of the cinder cone, Puu ka Pele, at 6,000 feet in 1942. An undated record from Donaghho (1937:8) cites 19 seen by Payne "between Mauna Kea and Hualalai." Vredenberg says Nene have occurred in Mamani groves above Kipuka Kalawamauna during recent years. Farther to the east S. Nakamura and an Hawaiian boy independently reported Nene at the cinder cone, Omaokoili, during April, 1943. One circled in flight over the Parker Ranch cabin a few miles east of Puu ka Pele when W. Rickard was there in 1939.

The eastern half of the plateau between Mauna Kea and Mauna Loa lies in North Hilo District. Here Aina Hou has continued to attract geese; however, Paris saw only a few there in the 1930's compared to numbers seen in the early 1900's. J. J. Ignacio saw 18 there in August, 1937 (Lamb, 1937:2), 8 in a single group in 1940, and 3 or 4 in 1941. Just above Aina Hou is another grassy *kipuka* called "Kipuka o Nene." Here von Holt saw a number during a visit in the 1930's and states that W. Kaneho frequently found Nene there on regular trips from 1940 to 1941. The elevation is 6,300 to 7,000 feet.

Toward Kilauea from Aina Hou, Hawaiian geese were seen on the south side of the lava flow of 1852 along the Puu Oo-Volcano Trail in the 1930's by Bryan. Recent Nene droppings were found on the flow of 1855 at 5,900 feet by the writer in November, 1942. Farther south, Wall saw flocks above Waiakea in the early 1900's.

North of Aina Hou the writer found droppings at several places along the edge of a lava flow and near small ponds three miles south of the Puu Oo Ranch house at 5,400 to 5,750 feet in November, 1942. H. Shipman occasionally has seen Nene on the Puu Oo Ranch during the past fifteen or twenty years.

Kau and Puna.—All of Puna and parts of Kau seem to have been abandoned by the Nene. Nowhere in these districts are there now to be found concentrations of the geese.

George Lycurgus knew of flocks coming to Kilauea Crater in the vicinity of the Sulphur Banks during the years 1904 to 1907. This is the last record at hand of wild geese in this constantly peopled area. An Hawaiian resident of the Kilauea region, the late Charles Kauhi, however, related that they occasionally would visit the barren Kau Desert to the southwest of the crater, though not the so-called "Kipuka o Nene" due south of the crater. A collection of perhaps month-old droppings was made by the writer in August, 1941, at the "Koa Oasis," two miles south of Kilauea Crater. The park warden reported four or five Nene at Kipuka Pepeiau in July, 1940.

Records of Nene occurrence above Kilauea Crater on Mauna Loa are numerous for the past few years because of the interest taken by employees of the Hawaii National Park and their frequent traversing of this area. The records are summarized in table 1. Though Nene have been recorded here frequently it is not an unusually favorable spot for them.

About five miles to the northeast of the park is Keawewai, a water hole where Nene stop rather frequently. Paris saw flocks there in the early 1900's. In July, 1940, ranchers likewise encountered a small flock and told me of seeing them there more recently.

On the Kau slopes of Mauna Loa, Nene also occur. Jaggar (1919:138) saw two in grassy Kipuka o Nene in Kahuku. In 1926, young were seen at Puu Kinikini by E. G. Wingate. On the slopes of Mauna Loa above the Kau Forest Reserve, Nene were sighted by E. Y. Hosaka in 1937 (Donaghho, 1937:8). M. Martinson saw two at Punaluu Kahawai at 7,250 feet in November, 1942. The occurrence of Nene in the Kahuku low-

lands in Kau is now rare, as Martinson, who is in that country frequently, has not seen any since 1931 or 1932, at which time he secured some goslings below Kipuka Kapulehu.

DISTRIBUTION ON ISLAND OF MAUI

Complete proof of the former existence of Nene on Maui is lacking, for no specimen is known to have been saved. Enough records are available, however, to indicate satisfactorily that a wild goose, presumably identical with the Nene, occurred on Maui. No specific breeding records are available.

The earliest mention of Nene on Maui is by Brigham (1909:12), who attributes them to the "highlands" in the 1860's. A hill at the base of Haleakala has always been called Puu Nene, "nene hill." By the 1890's the Nene was scarce on Maui, as Perkins (1903:457) writes, "The nene . . . is said to have formerly frequented Haleakala, Maui, although neither in my many visits to the summit, nor when camping in the bottom of the great crater, did I myself get sight of one." Henshaw (1902:103) writes that it "is said to have nested in past times in the crater of Haleakala. At the present time, however," he continues, "there is no reason to believe that the Nene is found upon Maui, inquiry in 1891 failing to disclose that it had been seen there for several years." Lorna von Tempsky says her father saw Nene at "Waikanene" at 7,700 feet on the north slope of Haleakala sometime around the turn of the century.

Since 1900 the Nene seems to have turned up as a rarity. David Fleming tells of seeing about six by small ponds on Laie Flats in Haleakala Crater in 1906. His brother, John, shot one on the slopes of Haleakala "above Paia" about the same time. Robert von Tempsky saw two at one of the ponds, Wai Anapanapa or Waiale, high on the northeast slope of Haleakala in 1912 or 1914.

NENE ON OTHER ISLANDS

It was the belief of some of the early residents that Hawaiian geese occasionally occurred on Kauai and Niihau. Von Holt tells that his mother, who lived on Kauai, spoke of seeing them there. Henshaw (1902:103) believes its occasionally recorded occurrence on Kauai and Niihau "was probably in the nature of an accident, if indeed it was not mistaken for one of the species of American geese which are known to visit the islands not rarely."

REDUCTION IN NUMBERS

Earliest available records indicate that a large population of Nene existed at least until 1823. Later ones show a decline, for in 1864, Brigham, although speaking optimistically, implied that the population on Hawaii was becoming smaller, as did MacFarlane in 1887. After 1890 we learn they are gone from Maui and scarce on Hawaii. From 1900 on the Nene has been rare.

Not having a numerical estimate of the original Nene population, for convenience we shall make our own. Twenty-five thousand may be a reasonable approximation: certainly the number was well up in the thousands. The number existing today is difficult to judge because of the bird's habitual movement and the remoteness of its feeding and breeding areas. Fifty was the figure proposed by Hawaii National Park staff members in 1939. This was a good estimate, but the size of flocks at Puuwaawaa in 1941 indicates the total may have been slightly larger at that time. Since 1941 the Puuwaawaa flocks have been smaller, however, and do not support an estimate of over 50.

The decline may have had a slow beginning in the late 1700's and gradually increased in speed until the high rate of decline was reached around 1850. From 1900

on the rate of decline fell and a lowest known population total was reached during the 1920's. From 1930 to the early 1940's the number was nearly constant. Bryan believes the Nene decreased until about 12 years ago and has remained static since, while Lindsey in 1942 thought the population at Puuwaawaa reached its lowest point in 1929 and had actually increased a little since then. The difficulty of detecting population trends is illustrated by Brigham's (1909:12) remark in 1864: "Although they are found only on the highlands of Hawaii and Maui, their number admits of the annual slaughter of several hundred without sensible diminution." This, at the time when the population curve was well into its sharp plunge.

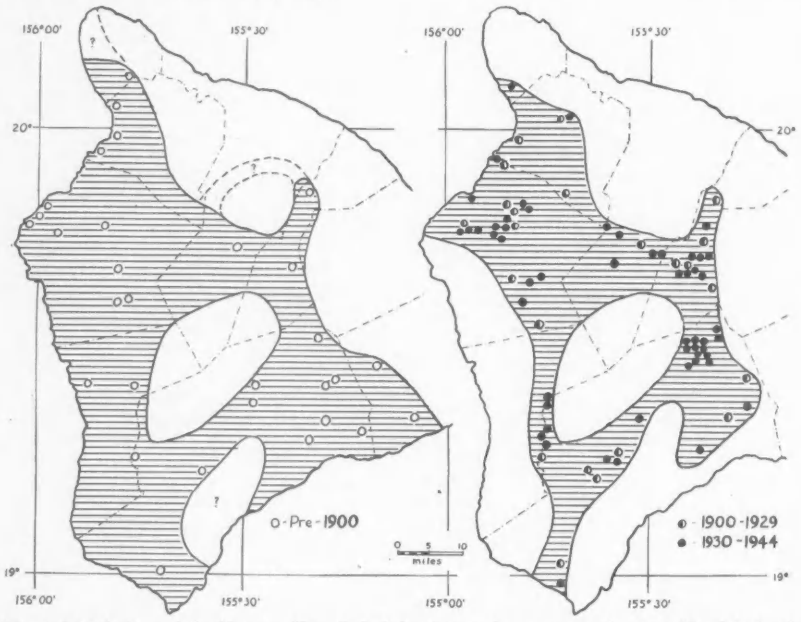

Fig. 8. Distribution of the Nene on Hawaii. Left-hand map shows range prior to 1900; right-hand map shows range after 1900. Circles indicate specific localities where Nene have been recorded. Nene may have entered areas marked with a question sign.

The causes of the decline were no doubt multiple. Direct influences were brought to bear upon the Nene by white man directly and indirectly through altered environment. The following list gives a few of the events occurring after civilization of the Western world penetrated the Hawaiian Islands:

Activities of man: exploration, hunting with firearms, probable increase in capture of live birds and eggs, flushing and frightening of birds from nests and foraging grounds, sandalwood gathering in uplands, ranching developments and activities, and building of beach resort homes and of military roads in uplands.

Indirect agents of the white man's activities: introduced animals such as the rat, goat, sheep, cattle, horse, pig (new stock), ass, feral dog and cat, mongoose, game birds (pheasant, quail, guinea hen, jungle fowl, turkey, peafowl), the mynah, and the ant. Introduced plants such as pasture weeds and grasses, mesquite, thimble-berry, and pampas grass.

Most of these factors have been adverse, but a few of the plants have provided preferred foods. Whatever the proportionate individual importance, the aggregate effect

caused the drastic reduction of the Nene population. Certain events leading to introduction of adverse factors can be dated easily, as, for instance, the introduction of the mongoose in 1883 (Bryan, 1915:296). This mammal is an important predator and egg destroyer, and an increase in its influence on the Nene can be anticipated henceforth. Activities of man are often intricate and devious in their effects. Ranching activities, for instance, include the establishment or introduction of cattle in paddocks, fences, buildings, water troughs, water sheds, trails and roads, camps, cats and dogs, heavy use of upland water holes by livestock, impoundment and piping of water from them, open water tanks (Nene drown in them), daily horseback trips by ranch hands into the paddocks, sowing of range grasses, clearing of brush by hand and burning, gradual reduction of vegetation from forest toward pasture type, and many others. The result of these cannot be so easily dated, but a gradual increase in deleterious effects is assumed from 1794, when cattle were introduced.

The extreme scarcity of the Nene in the late 1920's and early 1930's caused some to conclude erroneously that this bird had disappeared altogether from natural sites of occurrence. This was based partly on the fact that flocks at Puuwaawaa would come to the ranch house for food in a semi-domesticated manner. L. Hind has asserted that they were not held captive at the ranch but came of their own volition. In spite of the fact that Puuwaawaa flocks depended on man in part, during these same years Nene were still established as breeding birds elsewhere. The presence of young birds in the Kahuku uplands in 1927 and in the Kahuku lowlands in the early 1930's proves this. The continuity of the wild Nene population has remained unbroken.

The future of the Nene is uncertain. With no protection other than that of laws which prohibit shooting or molesting of the Nene, there is little prospect it will survive the present development of the island. That it has survived the last 15 years is perhaps evidence of ability to withstand the many adverse influences in spite of low numbers. This lends hope to the thought that means may be found to preserve the species.

REDUCTION OF RANGE

The early range of the Nene on Hawaii, as deduced from foregoing records, was more extensive than that now occupied. The range of 1800 is contrasted with that of 1900 to 1940 in figure 2. The former includes a total of 2,475 square miles, the latter 1,150. Thus shrinkage of range during 140 years amounted to over half the original range on Hawaii, or 1,325 square miles.

The range of the Nene on Maui apparently included lowlands as well as upper slopes of Haleakala and the crater itself. The lowlands must have been abandoned at an extremely early date and the uplands by the end of the 19th century. It is judged that the range on Maui was less than one-fifth that on Hawaii, or a maximum of 450 square miles. The two areas combined total 2,925 square miles, which represents the approximate size of the original range.

The reduction of range on Hawaii may well have occured in the following manner:

1. Before 1850: withdrawal from marginal areas and localities already in heavy use by Hawaiians.
2. 1850 to 1900: abandoning of wide lowland areas.
3. 1900 to 1944: slow shrinkage in uplands and lowlands.

In the first period, withdrawal from populated areas was given impetus by introduction of firearms. Whether or not Nene ever occupied the upper northern slopes of Mauna Kea and the extreme northern part of North Kohala is not actually known,

Table 1

Summary of Nene records in Hawaii National Park above Kilauea Crater from 1936 through February, 1944.

Locality	Date	Record	Source
Kipuka Kulalio	Aug. 25, 1938	Saw 5 in eastward flight, 6,250 ft.	P. H. Baldwin
	Aug. 28, 1938	One standing on lava flew into Koa forest, 5,750 ft.	P. H. Baldwin
	July 7, 1939	Saw 5 flying at 400 or 500 ft. in flat "V," 6,700 ft.	P. E. Schulz
	June 16, 1940	Saw flock of 3, 6,500 ft., and flock of 5, 6,000 ft. in flight.	P. H. Baldwin
	July 31, 1940	Small flock in underbrush, 6,700 ft.	P. H. Baldwin
	Dec. 18, 1943	One flushed from ohelo shrubs, 6,800 ft.	P. H. Baldwin
	Jan. 13, 1944	2 flushed, 6,500 ft., circled to higher elevation.	P. H. Baldwin
"3-trees Kipuka," ¼ mi. west Kipuka Kulalio, 6,250 ft.	July 21, 1937	Saw flock of 8	H. Craddock (1937), W. Donaghho (1937)
	April, 1940	Saw flock of 3 on 3 days.	P. H. Baldwin
	May, 1940	Saw flock of 2 on 2 days, 1 on 1 day.	P. H. Baldwin
	Oct. 22, 1940	Saw 2.	P. H. Baldwin
	Nov. 27, 1940	2 roosted during the night	P. H. Baldwin
	June, 1941	Abundance of signs indicates heavy use by Nene in May after little use in previous months	P. H. Baldwin
	Oct., 1941	Few signs indicate light use during October (first since May)	P. H. Baldwin
	Nov. 28, 1941	1 seen	P. H. Baldwin
1881 Lava Flow, 6,500 ft.	June, 1941	Signs indicate use of vicinity during May	P. H. Baldwin
Mauna Loa Trail	1936	Says Nene reported from time to time	K. J. Williams
	Sept., 1938	Saw 5, 7,500 ft.	B. F. Moomaw, Jr.
	Aug. 14, 1939	Saw 4, 7,500 ft.	E. S. Mollenhoff
	April, 1940	Saw 2, 7,500 ft.	H. J. Quick
	July 14, 1940	Saw 3, 7,500 ft.	J. H. Christ
	Oct. 15, 1940	Saw 1, 7,000 ft.	J. H. Christ
	Aug. 21, 1942	Saw 1, 7,800 ft.	P. H. Baldwin
	Mar. 3, 1943	Saw 1, 7,500 ft.	A. L. Mitchell
	Oct. 8, 1943	Saw 1, 7,500 ft.	A. B. Medeiros
	Feb. 21, 1944	Saw 1, 8,000 ft.	A. B. Medeiros

but it is possible they did. Inquiries have been made concerning the upper, northern portion of Mauna Kea without success as to discovery of either the early presence of Nene or reasons for its withdrawal if it ever was there. The Hawaiian crow is an example of a bird that seems not to occupy all available range; the Nene may likewise have failed to do so.

The second period coincided with the years of greatest reduction. Continued interference by man with Nene nesting in the lowlands was probably an important factor. The withdrawal may have resulted from extermination of Nene in the affected areas, the discontinuation of breeding by birds frequenting them, or by shifting of the breeding activities into other areas.

In the third period range shrinkage has continued through the 1930's. This might be interpreted as evidence of continuing population decline through the 1930's.

A characteristic of the changes in range and population just described is that the population continued to be spread out, but thinly, over a relatively large area. Thus, the population has undergone a much greater proportionate reduction than has the total areal range.

SUMMARY

The present range of the Hawaiian Goose, or Nene, encircles Mauna Loa on Hawaii between roughly 5,000 and 7,500 feet elevation and extends to or near the seashore in parts of Kau, North Kona, and South Kohala. Nene range was formerly more extensive on Hawaii than it now is, having decreased from 2,475 to 1,150 square miles. The Nene range of 1800 included larger tracts of lowland areas than that of 1900 to 1940. The present center of the Nene population is Puuwaawaa north of Mt. Hualalai.

Conclusive proof that the Nene existed on Maui is not available, although the species appears to have occurred there during the 19th century. Occurrence of the Nene on Kauai and other islands is doubtful. Nene range on Maui might have included about 450 square miles, bringing the total area occupied by the Hawaiian Goose up to a possible 2,925 square miles.

The wild Nene population may have totalled 25,000 or more in the latter part of the 18th century. It is now reduced to about 50 birds. The reduction began between 1778 and 1850, progressed rapidly between 1850 and 1900, and tapered off slowly from 1900 to 1930. Since 1930 the Nene population appears to have remained constant, although the available evidence may be deceptive. The continuity of the wild Nene population has not yet been broken. The Nene has survived during the past 15 years at a low population level.

LITERATURE CITED

Bell, E.
1929. Log of the Chatham. Honolulu Mercury, Sept., 1929.
Bloxam, A.
1925. Diary of Andrew Bloxam, etc. Bernice P. Bishop Mus., Spec. Publ. 10, 96 pp.
Brigham, W. T.
1909. The volcanoes of Kilauea and Mauna Loa. B. P. Bishop Mus., Mem. 11, No. 4, vii + 222 pp.
Bryan, W. A.
1915. Natural history of Hawaii, etc. (Honolulu, Hawaiian Gazette), 596 pp.
Craddock, H.
1937. Report of bird study project, by H. Craddock, Hawaii National Park. Mimeo., 4 pp.
Donaghho, W. R.
1937. Report of bird study project, by W. R. Donaghho, Hawaii National Park. Mimeo., 20 pp.
Ellis, W.
1917. Narrative of a tour through Hawaii, etc. Reprint of the London, 1827, ed. (Honolulu, Hawaiian Gazette), 367 pp.
Henshaw, H. W.
1902. Birds of the Hawaiian Islands, etc. (Honolulu, Thos. G. Thrum), 146 pp.
Jaggar, T. A.
1919. Monthly Bulletin, Hawaiian Volcano Observatory, vol. 7, 10:138.
Lamb, S. H.
1937. The Nene in Hawaii. Hawaii National Park. MS., 4 pp.
Locey, F. H.
1937. Introduced game birds of Hawaii. Paradise of the Pacific, pp. 5, 6, 27-30.
MacFarlane, J. R. H.
1887. Notes on birds in the western Pacific, made in H. M. S. "Constance," 1883-5. Ibis, ser. 5, 5:201-215.
Miller, A. H.
1937. Structural modifications in the Hawaiian Goose (*Nesochen sandvicensis*), a study in adaptive evolution. Univ. Calif. Publ. Zoöl., 42:1-80.
Peale, T. R.
1848. Mammalia and ornithology. United States Exploring Expedition, 8:i-xxv + 19-338.
Perkins, R. C. L.
1903. Vertebrata *in* Fauna Hawaiiensis (Cambridge University Press), 1:365-466.
Pope, W. T.
1932. The Hawaiian Goose or Nene. Hawaiian Annual for 1933, pp. 107-112.

United States National Park Service, Hawaii National Park, Hawaii, May 26, 1944.

FROM FIELD AND STUDY

California Condors in San Luis Obispo County, California.—On June 14, 1944, in the course of road-improvement operations on the Cholame Ranch about eight miles west of the northeast corner of San Luis Obispo County, the writer had the good fortune to see a flock of twenty California Condors (*Gymnogyps californianus*). I had pointed out a condor with its white wing patches to one of a road crew two or three years ago. When I arrived this morning, he said, "There are three of your condors." As we worked farther up the road, more and more condors appeared until there were twenty in the air circling above us.

They had been feeding on a carcass about two hundred feet west of the road, and the noise of road-grader engines frightened them away. After the graders had passed, the birds returned and I counted them again as they came in to the field. I was close enough to see the feathers at the tips of their wings bend up three or four inches from the air pressure just before they landed.

A few Turkey Vultures had also been attracted to the food, but these appeared small by comparison, and kept well out of the way of the condors. While tearing at the dead animal, the condors kept their balance by raising and partly extending their wings.—HALBERT T. JOHNSON, *Paso Robles, California, October 3, 1944.*

Notes on Raptors of the Boulder Area, Colorado.—The following observations were made in the period from September, 1941, to September, 1943.

Haliaëtus leucocephalus ssp.? Bald Eagle. The occurrence of the Bald Eagle along the Front Range in Colorado and its possible nesting there is of great interest to observers in that state. Several recent authors agree that it is a rare transient and winter resident in Colorado, although the following records would tend to indicate that it is much more frequent than was formerly thought.

On January 10, 1942, a single adult soared over the hills just south of the mouth of Lefthand Canyon, seven miles north of Boulder. On January 25, 1942, a single adult male (no. 4124, Univ. of Colo. Mus.) was shot four miles east of Boulder. On March 8, 1942, a large adult flew north by northwest along the palisades of Lefthand Canyon. On December 16, 1942, an immature bird was seen soaring south over South St. Vrain Canyon about three miles southwest of Lyons. On February 14, 1943, in Spruce Canyon, just below Fairview Peak, three miles west of Altoona, an adult was watched as it soared north at about 3 p.m., and at 3:20 p.m. a second bird, which was thought to be an immature Bald Eagle, was seen flying north at the same place as the first. On February 21, 1943, an adult Bald Eagle was attacked as it soared northward by the male of a pair of Golden Eagles nesting in Twomile Canyon. On March 10, 1943, an adult passed along the east face of the Dakota hogback at Twomile Canyon just north of Boulder. On March 21, 1943, two adults were observed as they left a patch of cottonwoods on the shore of Welch Reservoir, about four miles northwest of Berthoud. No nest was found but circumstantial evidence would indicate the nesting of this species in the Buckhorn Creek drainage. Unfortunately, it was not possible to investigate the various rumors of nesting.

Tyto alba pratincola. Barn Owl. In his recent list of additions to the birds of Boulder County, Alexander (Condor, 46, 1944:36) states that "the status of the Barn Owl in this region is somewhat uncertain. Although there is little evidence for nesting, the bird has been considered a possible resident." On November 27, 1941, a young Barn Owl was found dead at the foot of the cliff making up "White Rocks" about seven miles east of Boulder. This owl was about six weeks old and could not have flown any great distance. Pellets and excrement indicated the long residence of this species. Shortly after the finding of this first specimen, an adult male was found dead at the same location. The following year, 1942, fresh pellets of this species were observed. The discovery of this young owl establishes the breeding of this species at "White Rocks," and provides another record of very late nesting in this species (see Walker, Migrant, 4, 1943:80).

The Barn Owl is of regular occurrence in the Pawnee Buttes and Chalk Bluffs area of northeastern Colorado, and the finding of a molted feather in the hogback area north of Boulder would indicate its occurrence there. This owl should be considered as a scarce resident on the plains up to the foothills, with centers of abundance in the dry bluff areas of eastern Colorado.

Asio flammeus flammeus. Short-eared Owl. The following observations provide some evidence of the sporadic occurrence of this species. Niedrach and Rockwell (Birds of Denver and Mountain Parks, Denver, 1939:96) speak of the Short-eared Owl as a winter visitor in the Denver area, and Alexander (Univ. Colo. Studies, 24, 1937:94) writes as follows: "infrequent; plains and foothills; considered a winter visitant by Betts [Univ. Colo. Studies, 10, 1913:196, two fall and three spring

records], but probably is a resident." According to Bergtold (A Guide to the Birds of Colorado, 1928:109), upon whose account Alexander bases his statement, the Short-eared Owl is a "frequent resident; mostly on plains but also up to 8000 feet; . . . most common in northern Colorado in summer." The basis for this statement is open to question; in any event field observations would indicate that the Short-eared Owl is at best a rare or only sporadic resident in northeastern Colorado. On June 10, 1942, Short-eared Owls were seen in three separate localities in the area north and northeast of Fort Collins, Colorado. The first group, an adult with several nearly grown young, was flushed from a roadside ditch near the main highway between Fort Collins and Cheyenne about 15 miles north of Fort Collins. As we proceeded toward Fort Collins, going first some distance to the east, other adults were seen perched on fence posts. The last bird was observed about five miles northeast of Fort Collins. It appeared that in this area, at least, the owls were fairly abundant. In 1943 this general area was visited on three occasions, but no owls were noted.

It is possible that during certain periods the Short-eared Owl may nest as far south as Boulder County, but until breeding birds are actually observed it should be listed from there only as an infrequent winter resident.—MALCOLM T. JOLLIE, *Museum of Vertebrate Zoology, Berkeley, California, December 20, 1944.*

Diving Habits of the Shoveller Duck.—Shoal-water or river ducks of the subfamily Anatinae normally obtain their food on land, on the surface of the water, or by tipping. Rarely are surface feeders found diving for food, although they experience no difficulty in diving to evade enemies during the period of molt and when crippled.

On September 21 and 22, 1942, at a small pond on the Bosque del Apache National Wildlife Refuge, some 10 miles south of San Antonio, New Mexico, the writer observed three to five male Shovellers (*Spatula clypeata*) repeatedly diving for food. The pool was 2 to 3 feet deep and had been formed by a washout during a serious flood down the Rio Grande River. The dives were clean-cut actions; the birds disappeared completely under the water and submerged for several seconds at each dive. Furthermore, the diving seemed to be a concerted action, that is, if one Shoveller dived, the others did so immediately. This abnormal feeding habit was probably the result of insufficient surface food in the particular section of the country where the birds were accustomed to feed; consequently, they had learned to dive for their food.

On a number of occasions the writer has seen Black Ducks and Mallards dive—in a protected area that had been baited—for wheat or corn placed 2 to 4 feet in the water.—CLARENCE COTTAM, *United States Fish and Wildlife Service, Chicago, Illinois, November 13, 1944.*

Foster Parentage of a Mourning Dove in the Wild.—Adoption or foster parentage among birds in the wild apparently is not a common occurrence. There are relatively few instances recorded in the literature, and most of these appear to concern adoption of a juvenile after it has left the nest in which it was hatched; in one such case reported by the writer (Bird-Lore, 28, 1926:334), a towhee (*Pipilo erythrophthalmus*) cared for a juvenal cowbird (*Molothrus ater*) which had been hatched in the nest of an Orchard Oriole (*Icterus spurius*).

An interesting case of adoption was observed in 1941 by Lee W. Arnold of the Arizona Game and Fish Department. Arnold and the writer were studying the life history of the White-winged Dove (*Melopelia asiatica*) in the big mesquite thicket on the Gila River Indian Reservation south of Komatke, Arizona. A blind had been set up near a nest containing two squabs about three days old, and at 5:14 a.m., sun-time, on August 12, 1941, Arnold entered the blind for the purpose of obtaining a full day's record of the care of the young doves. The adult female flushed from the nest at his approach and another adult flushed from the same tree; the female returned to the tree at 5:22 and to the nest at 5:35. At 5:52 another adult perched briefly in the tree, but after that hour no other White-wing entered the tree during the day.

At 7:34 a.m., about the normal hour for the adults to make their regular exchange in parental duties, the brooding female became restless and suddenly left the nest and flew from sight. From that hour until 4:36 p.m., sun-time, no adult White-wing appeared near the nest, though at intervals it was in full sunlight. Several species of birds inspected the nest and young doves during the day, but none attempted to harm them.

At 3:11 p.m., a Mourning Dove (*Zenaidura macroura*), apparently attracted by the peeping of the hungry youngsters, alighted near the nest and inspected the young White-wings, then walked to the nest and immediately began to brood them. From 3:13 to 3:50, the Mourning Dove fed the young White-wings several times and continued to brood them.

At 4:36 p.m., sun-time, after an absence of nine hours and two minutes the female White-wing returned to the nest and immediately attacked the Mourning Dove. Both fought with heads drawn in, tails spread fan-wise, both wings raised, striking with the elbows of the wings. For some two minutes a battle raged, but the greater size of the White-wing prevailed, and the Mourning Dove was driven away. The White-wing settled down upon the nestlings and continued to brood until dark.

Five days later, August 17, Arnold and the writer visited this nest at 9:00 a.m. and found the Mourning Dove again brooding the young White-wings. On August 26 the writer visited the nest again one youngster was gone, but the other and the adult Mourning Dove were perched side by side on a dead branch some 15 feet from the nest and fluttered away together at my approach.

These observations leave much unexplained. Arizona White-winged Doves normally migrate southward by mid-August; possibly the male of this pair had tired of family duties and joined migrating flocks, or he may have been killed. The female appears to have continued to observe normal hours of nest duty for at least a few days, after which she also apparently deserted her brood. The nest of the Mourning Dove containing infertile eggs some 20 feet from the White-wing nest may offer plausible explanation for the maternal instinct of the female Mourning Dove.

On several earlier occasions the writer had observed a White-winged Dove upon a nest only to find a Mourning Dove occupying it on a later visit and then a White-wing at a third visit; inspection had proved the nest to contain young White-winged Doves. Some of these instances may have been further cases of temporary adoption by the Mourning Doves.

Experimental exchange of eggs between nests of Mourning Doves, White-winged Doves, albino aviary doves, and Ring-necked Doves (*Streptopelia risoria*) proved that none rejected either the eggs or the young after they had hatched, even though there was a marked difference in appearance of the newly hatched albino young. Newly-hatched squabs of the Mourning and White-winged doves were also interchanged without ill effect and continued to grow in normal manner. Personal observations and reports from several aviaries in Phoenix also indicate that several species of aviary doves and the Mourning Dove are all quick to adopt or assist in the care of young doves of any species hatched in the aviary cages. Two seasons of study of caged White-wings, however, did not indicate that this species shares that habit.—JOHNSON A. NEFF, *United States Fish and Wildlife Service, Denver, Colorado, May 4, 1944.*

Kingfisher Nesting Near Whittier, California.—A pair of Belted Kingfishers (*Megaceryle alcyon*) nested in the Whittier area during May, 1944, and, it is believed, raised at least two young. On May 13, a kingfisher was seen entering a tunnel in a bank along a stream. Several times each day, on May 15, 17, and 19, it was observed carrying fish into the hole. This species is exceptionally shy about the nest, as my first observation disclosed. A male with a good sized fish in his bill perched on a limb above the water at some distance from the tunnel and rattled continuously; not until I moved farther away to an inconspicuous position did he enter with the fish. On May 24 a female and a young bird were observed near the nest, and another individual, presumably a second juvenile, was seen in the mouth of the hole. On May 30 three birds were noted, but after this date no kingfishers were seen about the site. It was not possible to see the nest as a bend occurred in the tunnel about three feet from the entrance. The three birds probably were of the same family as such a pugnacious and solitary species as this would not tolerate the presence of others of its kind. Willett (Pac. Coast Avif. No. 21, 1933:99) reports that this species nested in the Whittier area in 1895. Possibly the locality of that record is approximately the same as that reported above. There are several other records for southern California, but the species is sufficiently uncommon, we believe, to deserve this additional notice.—J. H. COMBY, *Whittier, California, December 1, 1944.*

English Sparrows versus Robins.—On May 7, 1944, a pair of Robins (*Turdus migratorius*) was discovered to have a nest in a willow, near Reno, Nevada. The nest was apparently completed and ready for eggs, but a pair of English Sparrows (*Passer domesticus*) repeatedly tried to take possession of the nest, adding loose nest material on top and often successfully driving the robins away. The male sparrow was shot when this had gone on for at least three days. The robins had evidently deserted the nest at about this time, however, and two robin's eggs, one unbroken, were found on the ground below the willow. But the robins were only temporarily defeated, for a few days later they quickly (in a day and a half) made a new nest in a poplar seventy-five feet away. There they raised a brood without incident. Almost certainly this same pair of robins raised a second brood in a third nest built in an adjacent poplar. Loose sparrow nesting material was found in the second nest after the young robins had left.—FRANK RICHARDSON, *University of Nevada, Reno, Nevada, September 20, 1944.*

Lawrence Goldfinch Eating Egg of Mourning Dove.—On June 1, 1944, I noticed a female Lawrence Goldfinch (*Spinus lawrencei*) in a gulch overgrown with weeds. It flew into the lower branch of a small oak tree and there ate something in the nest of a Mourning Dove. I approached to learn what was of so much interest to this bird. In the nest were two eggs; one was whole and the other was punctured. The Lawrence Goldfinch was eating the contents of the egg. I have watched many Lawrence Goldfinches, but have never before seen them feeding on the eggs of any species of bird. While they are not so common here as the Green-backed Goldfinch, they are not scarce. I do not know how the egg of the dove was first punctured; whether it was pierced by this goldfinch or not is open to question. The puncture, however, was not very large.—JAMES L. ORTEGA, *Paso Robles, California, August 1, 1944.*

Snow Bunting in New Mexico.—In the Museum of Natural History at the University of Kansas there is a Snow Bunting (*Plectrophenax nivalis nivalis*), no. 6621, for which the catalogue entry reads "Dec. 16, 1886 Las Vegas Mts. New Mexico Coll. by Allie Harvey Orig. # 455 Mtd. by L. L. Dyche." This specimen probably was obtained at or near the Harvey Ranch, about twenty-five miles by trail up the Gallinas River (northwest) from Las Vegas, San Miguel County, New Mexico, in what are oftener referred to as the Sangre de Cristo Mountains. Dyche collected specimens in several seasons in the vicinity of the Harvey Ranch and in the published account of this collecting (see C. E. Edwords, Camp-fires of a Naturalist, New York, D. Appleton and Company, 1893) by name mentions Allie Harvey. I know of no other records of the Snow Bunting in New Mexico, nor of any record elsewhere in the western United States as far south as the latitude of this occurrence in the Sangre de Cristo Mountains.

The southern limit of range for the Snow Bunting, west of the Mississippi River, as known from extralimital occurrences—all in winter—is a line from Camp Harney in Oregon, eastward along Utah Lake, Utah, to the Sangre de Cristo Mountains of New Mexico, Wichita, Kansas, and Covington, Louisiana. Of these records, the four previously published are: Oregon (Bendire, Proc. Boston Soc. Nat. Hist., 19, 1877:117); Utah (Johnson, Wilson Bull., 47, 1935:160); Kansas (Isley, Auk, 29, 1912: 43); Louisiana (Oberholser, Louisiana Dept. Cons., 28, 1938:679).—DONALD F. HOFFMEISTER, *Museum of Natural History, University of Kansas, September 21, 1944.*

Another Southern California Record of the Tennessee Warbler.—On October 7, 1944, shortly after 3 p.m., an adult female Tennessee Warbler (*Vermivora peregrina*) was found in our water trap at Hollywood, California. Before removing the bird to band it, we noted that it was different from any warbler we had banded. With the bird in our hand, Mrs. Duff and I checked it with descriptions and pictures in a number of authoritative sources, and unquestionably it was a female Tennessee Warbler.

Willett (Condor, 45, 1943:74) pointed out that the four records of this species in southwestern California are of birds found during the month of September. This record seems to be the first for October.—C. V. DUFF, *Hollywood, California, October 21, 1944.*

NOTES AND NEWS

At a meeting of the Board of Regents of the Smithsonian Institution, held on January 12, 1945, Dr. Alexander Wetmore was elected to the post of Secretary. He has served as Assistant Secretary of the Institution since 1925.

Ernst Mayr's "Birds of the Southwest Pacific" (Macmillan Company, New York) has recently come off the press. This book is priced at $3.75. Included are three color plates showing 39 species and 16 additional black-and-white figures.—F. A. P.

Ronald Ward Smith, a member of the Cooper Club since 1939 and an associate of the American Ornithologist's Union since 1932, was killed in action on September 11, 1944.

The son of the late Mr. and Mrs. James W. Smith, he was born at Halifax, Nova Scotia, May 21, 1913. His whole life was a cheerful and determined struggle to educate himself and to achieve his goal, to be a zoologist.

One of the several young men who owe their start along this path to the kindly and efficient direction of Robie W. Tufts of Wolfville, Nova Scotia, Ronald commenced his pursuits at the latter place in the Annapolis Valley, the scene of Longfellow's "Evangeline." Here the present writer first met him in 1930, a keenly intelligent lad of 16, gifted with a happy and attractive personality.

Graduating from the University of Acadia in 1934 with the degree of Bachelor of Science, he later studied at the University of California, receiving his M.A. degree in 1939. Between these years he did considerable careful collecting of both birds and mammals, chiefly for the Cleveland Museum of Natural History, joined several expeditions to different regions in the western states, California, Nevada, Idaho and Wyoming, and in February, 1937, was a member of an expedition to the Galapagos Islands in the interests of the Philadelphia Academy of Natural Sciences. In addition he carried on much intensive work in his native province collecting land mammals and land and sea birds, his specimens being models of excellent preparation.

For some time he was attached to the Canadian National Museum at Ottawa learning the higher arts of taxidermy and modeling, in both of which he became singularly adept. His last position was as Curator of the Museum of Queens University, Kingston, Ontario.

Shortly after the outbreak of war, he enlisted in the Royal Canadian Air Force where the assiduity that characterized his whole life brought him rapid promotion. After a long period of training he went overseas early in 1943 as Flight Sergeant, becoming Pilot Officer in 1944. He was on many bombing raids over enemy territory during the first half of this year and was looking forward to an early spell of leave when on September 11, while in command of a heavy bomber in a raid over Rauxall, Germany, he was mortally wounded but brought his craft back to England to be killed in a crash landing at Linton, Yorkshire. To the very end he gave his best.—ALLAN BROOKS.

The passing of M. French Gilman on July 18, 1944, marked the end of a chapter in the early observation of desert bird life in California and Arizona. Although many able ornithologists in the southwest carry on, Gilman was pre-eminent in the study of the lives of desert birds by reason of a lifetime spent with them. Banning, in San Gorgonio Pass, was the home of the Gilman family. Near here, on November 12, 1871, French Gilman was born, the grandson of the first white settlers of the region. At the age of 13 he already had built an egg collection and had early made the acquaintance of Wilson C. Hanna and the late Robert B. Herron. This group of naturalists later enjoyed many trips together searching for birds and nests. Gilman was vigorous and most notably a man of the out-of-doors. Hanna, recently commenting on this, writes: "He was a tireless walker and only a few years ago I had a letter from him while he was in Death Valley saying that he had been ill and when the doctor let him get up he walked to the top of Telescope Peak [11,000 ft.] and returned to see if he was O.K." It was from Death Valley in later years, where he was custodian, that he reported many significant distributional records in the Condor. Earlier while working for the Indian Service he contributed important articles on the life histories of thrashers, owls, woodpeckers, towhees and warblers of southern Arizona, most notably as observed at the Indian reservation at Sacaton. Appropriately, the Screech Owl of the desert country bears his name, *Otus asio gilmani*. Besides having an ornithological interest he was a field botanist of real ability. He assisted Dr. Frederick V. Colville in making a survey of the plant life of Death Valley and engaged in establishing a botanical garden of desert plants there. Truly he merits the characterization of pioneer naturalist of the southwestern deserts (see Condor, 42, 1940:225, photograph).—ALDEN H. MILLER.

MINUTES OF COOPER CLUB MEETINGS

NORTHERN DIVISION

SEPTEMBER.—The regular monthly meeting of the Northern Division of the Cooper Ornithologi-

cal Club was held on Thursday, September 28, 1944, at 8:00 p.m., in Room 2503 Life Sciences Building, University of California, Berkeley, with about 45 members and guests present and President Robert C. Miller in the chair. Names of newly proposed members were: John Roscoe Hendrickson, Department of Zoology, University of California, Berkeley 4, California, proposed by Alden H. Miller; Walter Alexander Hicks, 3120 Lewiston Ave., Berkeley 5, California, proposed by Junea W. Kelly; Elmer Joseph Koestner, Lt. (j.g.), U.S. Naval Air Station, Pensacola, Florida, proposed by Frank A. Pitelka; and Oliver Ledlie Smith, 15 York Ave., Towanda, Pennsylvania, proposed by Alden H. Miller.

The program of this meeting consisted of three short talks. Mr. Wade Fox, Jr., reported his observations of the nesting of Red-breasted Nuthatches on the Berkeley campus. He found that unmated birds foraged over a larger territory and made less effort to protect it against intrusion than did a mated bird, which drove off California jays, linnets, and other nuthatches which came too close to its nest. In basic pattern the songs of breeding males were noticably longer than those of unmated birds.

The second talk, given by Mr. Malcolm T. Jollie, concerned the nesting of Sharp-shinned Hawks in Strawberry Canyon. On May 14 a nest containing four eggs was discovered in a yellow pine; a week later it contained five eggs. The eggs were found pipped on June 18; thus, the incubation period was about five weeks. The weights of the young sharp-shins, when compared with the average weights of adults, indicated that there were four males and one female. At 14 to 15 days after hatching, their weights approximated those of adult birds. Feather growth was still only about one-third to one-half completed at the age of one month. Mr. Jollie compared the known incubation periods of several species of hawks ranging from small accipitrines to eagles, and found them all to be approximately five weeks.

Mrs. G. Earle Kelly discussed ecological preferences of some western shore-birds on the Monterey Peninsula and Point Lobos. On certain beaches of the former area, she observed local concentrations of shorebirds, including the Black and Ruddy turnstones, Surfbirds, Wandering Tattlers, Sanderlings, and Snowy and Semipalmated plovers. Beaches near Point Lobos, comparable to those of the Monterey peninsula in a number of physical characteristics, were not frequented by these shore-birds. Apparently food, here chiefly insects associated with accumulations of algae thrown up by waves, was an important factor determining the presence or absence of these birds.

Adjourned.—ALICE S. MULFORD, *Recording Secretary*.

OCTOBER.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, October 26, 1944, at 8:00 p.m., in Room 2503 Life Sciences Building, University of California, Berkeley, with about 25 members and guests present and Vice-President Lewis W. Taylor in the chair. Mr. Ian I. McMillan of Shandon, California, was proposed for membership by Alden H. Miller.

Mrs. Junea Kelly reported seeing the Red-backed Sandpiper for the first time this season in Alameda on October 7; flocks of this species were present there on October 24. Miss Alice S. Mulford reported an observation of four Black-billed Magpies at Graeagle, Plumas County, California, about August 16.

The speaker of the evening was Dr. Alden H. Miller, who presented an account of a field trip conducted in summer, 1940, to the Grapevine Mountains, Death Valley National Monument. Dr. Miller described the physical characteristics of the mountains and the dominant vegetation. He compared the avifauna of the lower zone of open, park-like piñon-pine forest with that of the upper zone of dense piñon forest. He related the occurrence of the various species of birds to the character of the vegetation and to the temperature changes accompanying rise in altitude.

Adjourned.—ALICE S. MULFORD, *Recording Secretary*.

NOVEMBER.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, November 30, 1944, at 8:00 p.m., Room 2503 Life Sciences Building, University of California, Berkeley, with President Robert C. Miller in the chair and about 27 members and guests present. Herbert Wilson, 902 Morris Ave., Modesto, California, was proposed for membership by Allan Brooks; Jerome Begun, 858 44th Ave., San Francisco 21, was proposed by Alden H. Miller.

The speaker of the evening was Mr. Laidlaw Williams who discussed his color-band studies of Brewer Blackbirds at Carmel Point, near Monterey, California. He began his studies in February, 1942. In this species, there appears to be no definite territory. The male fights for the female wherever she is and protects the nest. A few individuals are known to have kept the same mates for several years. A few were polygamous. Mr. Williams concluded his talk with a comparison of the Brewer Blackbird with other icterids.

Adjourned.—ALICE S. MULFORD, *Recording Secretary*.

DECEMBER.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was called to order by Vice-president Lewis W. Taylor on Thursday, December

28, 1944, at 8:00 p.m., Room 2503 Life Sciences Building, University of California, Berkeley, with about 30 members and guests present. The president's appointment of a committee to nominate officers for 1945 was announced: Dr. Seth Benson, chairman, Miss Hope Gladding, and Miss Grace Crowe.

Dr. Sumner C. Brooks discussed "Biological Notes on a South American Trip." His account began at Manzanillo, Mexico, where he saw wintering North American birds. The trip continued southward along the Pacific Coast by boat, car, and plane, thence across the southern end of Argentina, and up the Atlantic Coast to Rio de Janeiro.

Adjourned.—ALICE S. MULFORD, *Recording Secretary.*

SOUTHERN DIVISION

SEPTEMBER.—The regular monthly meeting of the Southern Division of the Cooper Ornithological Club was called to order by President A. J. Van Rossem at 8:15 p.m., Tuesday, September 26, 1944, in Room 145, Allan Hancock Foundation, Los Angeles, California. Applications for membership were read, as follows: Allan Cecil Brooks, % Livestock Insect Laboratory, Kamloops, British Columbia, proposed by Maj. Allan Brooks; Henry Taylor Wiggin, 151 Tappan St., Brookline 46, Massachusetts, proposed by W. Lee Chambers; Mrs. Florence Becker Lennon, 842 Grant Place, Boulder, Colorado, proposed by Mrs. N. Edward Ayer; and Miss Dorothy Groner, 701-C Hall of Justice, Los Angeles 12, California, proposed by George Willett.

"A Preliminary Report of Studies in the Ecology of the California Woodpecker" was given by the Secretary.

Adjourned.—WALTER W. BENNETT, *Secretary.*

OCTOBER.—The regular monthly meeting of the Southern Division of the Cooper Ornithological Club was called to order by Vice-president Ed. Harrison at 8 p.m., Tuesday, October 31, 1944, in Room 145, Allan Hancock Foundation, Los Angeles, California. The membership application of Mr. Luther F. Keeton, 75 N. Cleveland Ave., Memphis 4, Tennessee, proposed by W. Lee Chambers, was read.

A talk on the "Life History of the White-tailed Kite" was given by Ed. Harrison and Francis Roberts. He reported one nest in San Diego County in which the first egg was laid on March 2; the set was completed on March 14. The incubation period lasted about 29 days. The young could fly in approximately five weeks. Because incubation began when the first egg was laid, the young were of varying sizes while in the nest. The adults had a second nest 21 days after the hatching began in the first nest. The first egg of a second pair was laid on March 20; the clutch was completed on March 28. The first young hatched on April 23, the last on April 30, taking approximately 28 days for incubation. Mr. Harrison's studies have been confined to a colony begun by a single pair in 1939 and increased to nine pairs by 1944. Only the early nesters breed twice in the same year.

Adjourned.—WALTER W. BENNETT, *Secretary.*

NOVEMBER.—The regular monthly meeting of the Southern Division of the Cooper Ornithological Club was called to order by President A. J. van Rossem at 8 p.m., November 28, 1944, in Room 145, Allan Hancock Foundation, University of Southern California, Los Angeles, California. The following applications for membership were read: Mrs. Bertha Stevens, 30 W. Missouri Ave., Phoenix, Arizona, proposed by C. T. Vorhies; John S. Wong, P. O. Box 452, Delano, California, proposed by W. Lee Chambers; Mrs. Myra Dodge, Henderson, Nevada, proposed by Beatrice W. Nielsen; Mattonri M. Young, R. F. D. 3, Ridgefield, Connecticut, proposed by W. Lee Chambers; George Rowland Marfield, 1820 S. Olive Ave., Alhambra, California, by John McB. Robertson; James Ortega, Creston Star Route, Paso Robles, California, proposed by A. H. Miller; and William (Wallace) Bailey, 553 Michellenda Ave., Pasadena, California, proposed by W. Lee Chambers.

It was moved by George Willett, seconded by Dr. I. N. Nokes, and duly carried, that a resolution concerning the death on October 22, 1944, of the Club's former president, Dr. Guy C. Rich, be accepted as an expression of the organization, as follows:

WHEREAS, in the death of Dr. Guy C. Rich, on October 22, 1944, the Cooper Ornithological Club has lost a member of more than thirty years standing, a former President of the Southern Division, and a member of the Board of Governors; and

WHEREAS, during the last years of Dr. Rich's life, even after complete loss of his eye-sight, his interest in the welfare of the Club was not lessened, and his unfailing cheerfulness was in inspiration to all who came in contact with him;

THEREFORE, BE IT RESOLVED, that the Southern Division of the Cooper Ornithological Club here express its sorrow at the loss of our good member and valued friend; and

BE IT FURTHER RESOLVED, that the Secretary be instructed to place one copy of these resolutions on the minutes of this meeting, and to send another copy to Mrs. Rich with an expression of our sincere sympathy.

A lecture on "Life-zones as a Background in Natural History" was given by Mrs. Mary V. Hood.

Adjourned.—WALTER W. BENNETT, *Secretary.*

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MISCELLANEOUS PUBLICATIONS

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Catalogue of an exhibition of bird paintings by Lynn Bogue Hunt, sponsored by the Southern Division of the Cooper Ornithological Club at the Los Angeles Museum, April, 1929; 16 pp., portrait of Lynn Bogue Hunt, and 7 half-tones - - - - - - - - - $ .25

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Other Publications

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By C. BARLOW

Report of the Birds of Santa Barbara Islands. Pub. No. 1, Pasadena Acad. Sci., August, 1897; 26 pp. - $1.00
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